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THE IRON TRADE REVIEW

VOLUME XXXII. CLEVELAND, O. DECEMBER 21, 1899. CHICAGO, ILL. NUMBER 51

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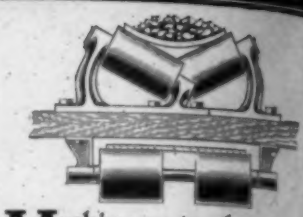

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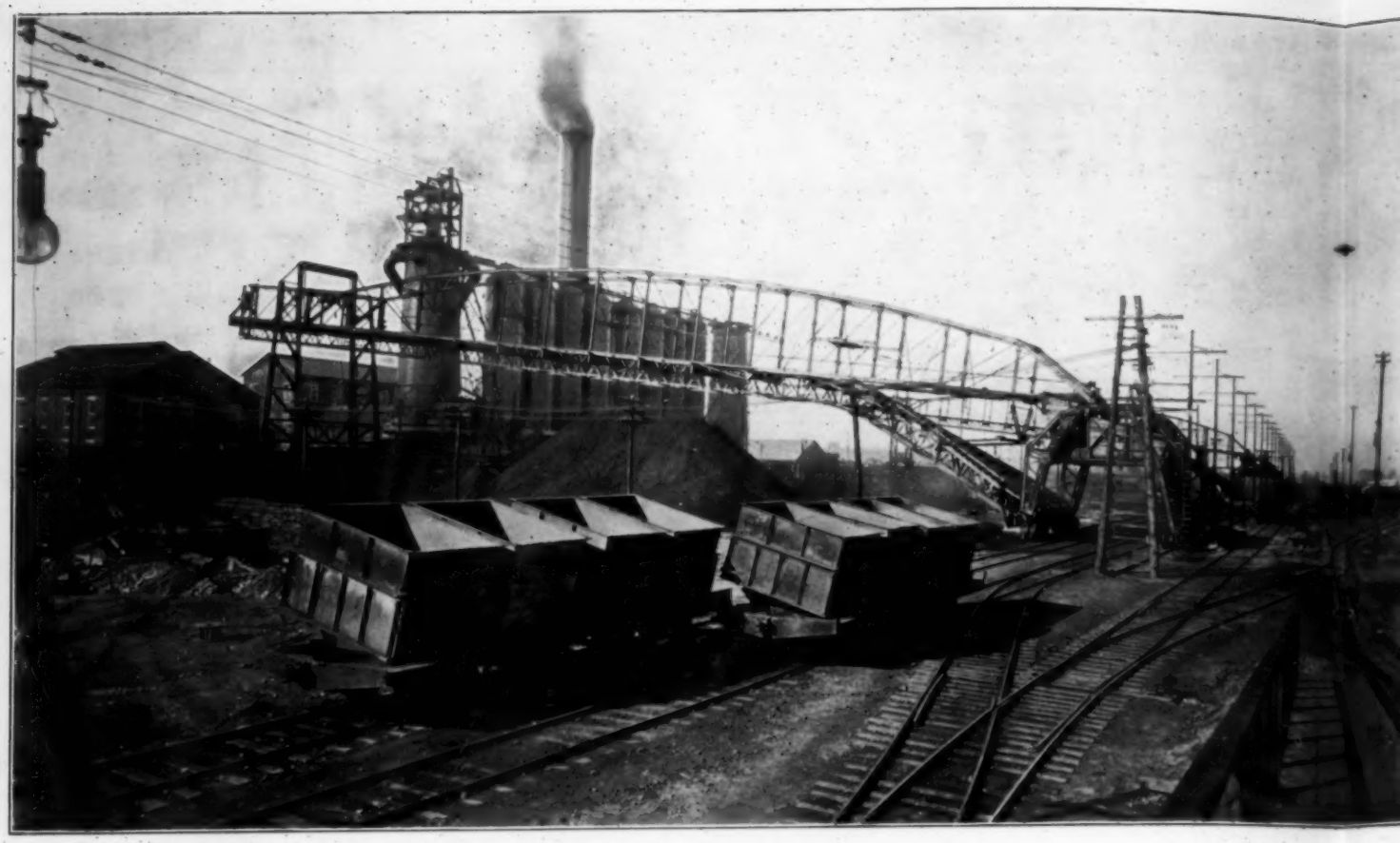

FIG. 1.—GENERAL VIEW OF FURNACES, ORE PIT AND BRIDGES, WITH ORE TRANSFER CARS IN FOREGROUND. YARD FOR LOADED CARS ON RIGHT.

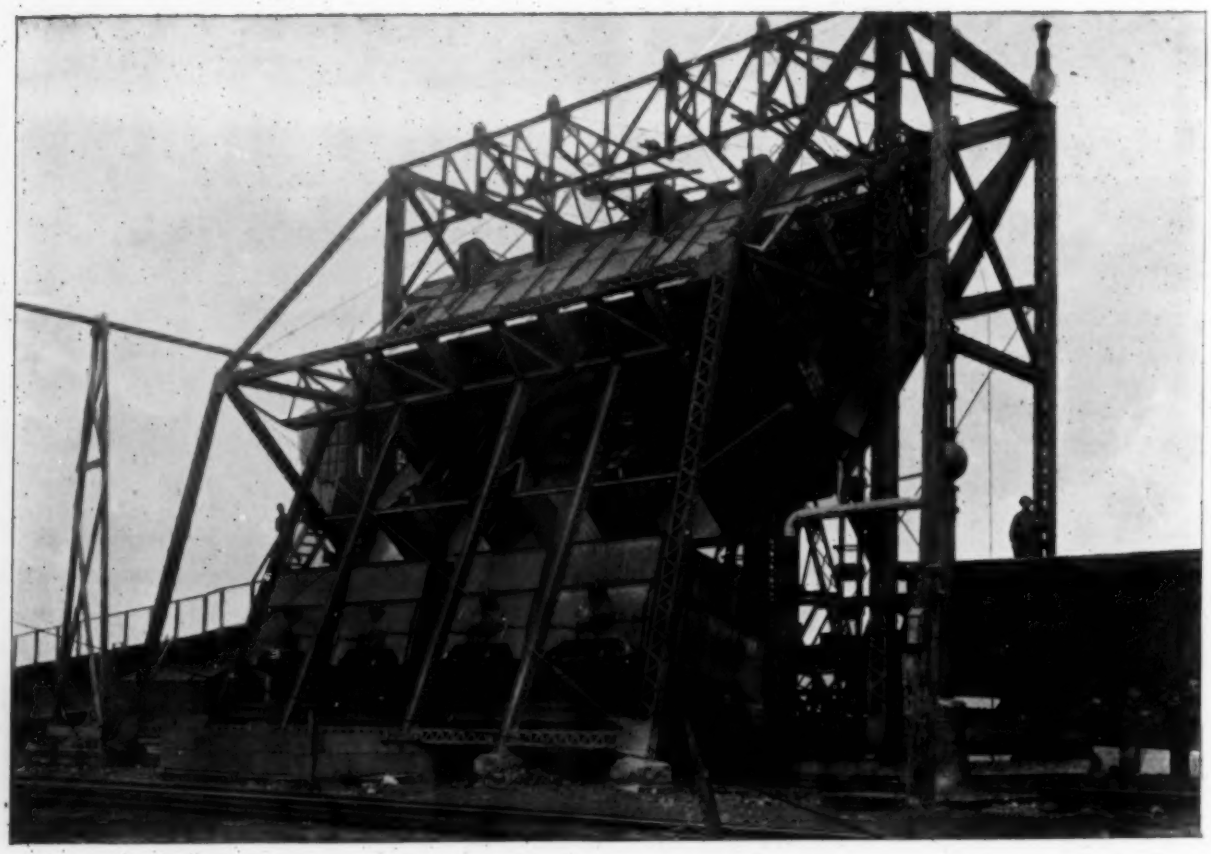

FIG. 3.—HULETT ORE CAR DUMPER.

Views of the New Blast Furnaces at the Ohio Wor

IS ON RIGHT.

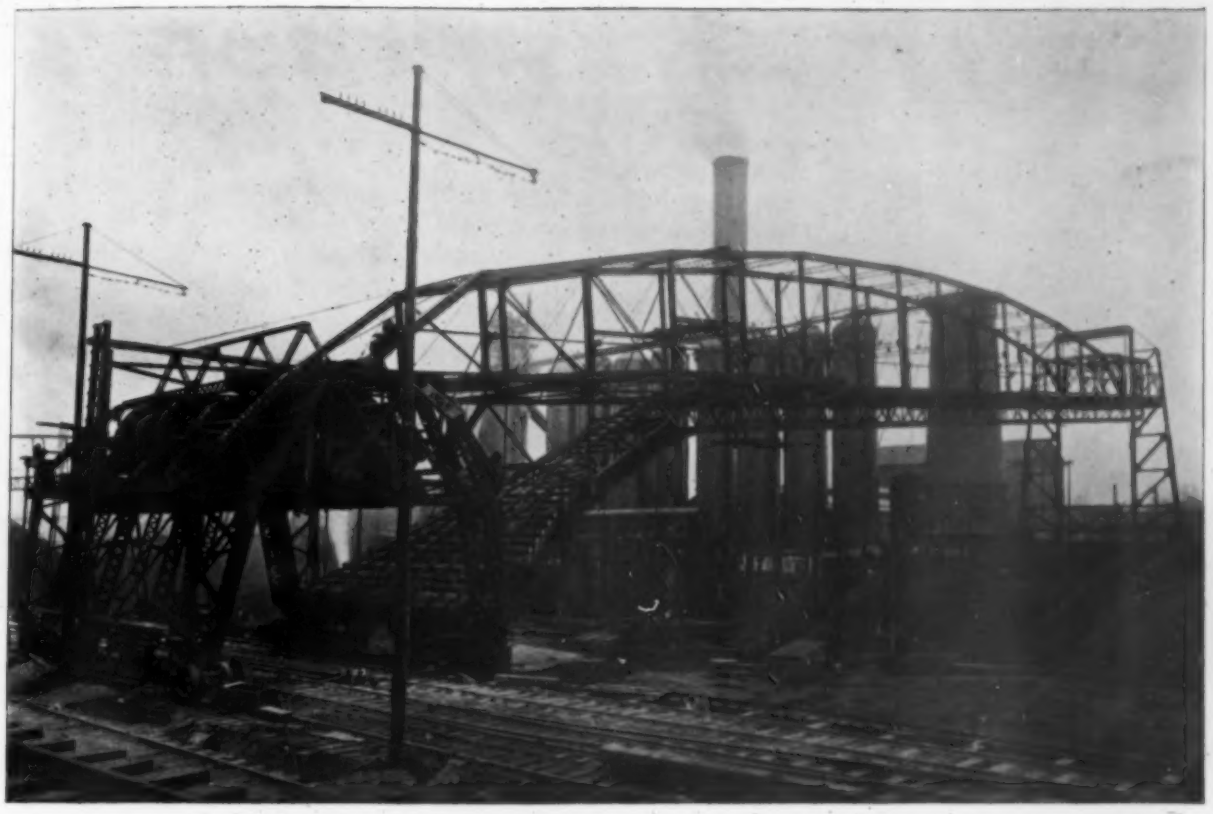

FIG. 2.—VIEW OF ORE BRIDGE SHOWING OPERATING TOWER AND DRUMS FOR HAULAGE, ALSO THE FOUR CONVERGING INCLINED TRACKS.

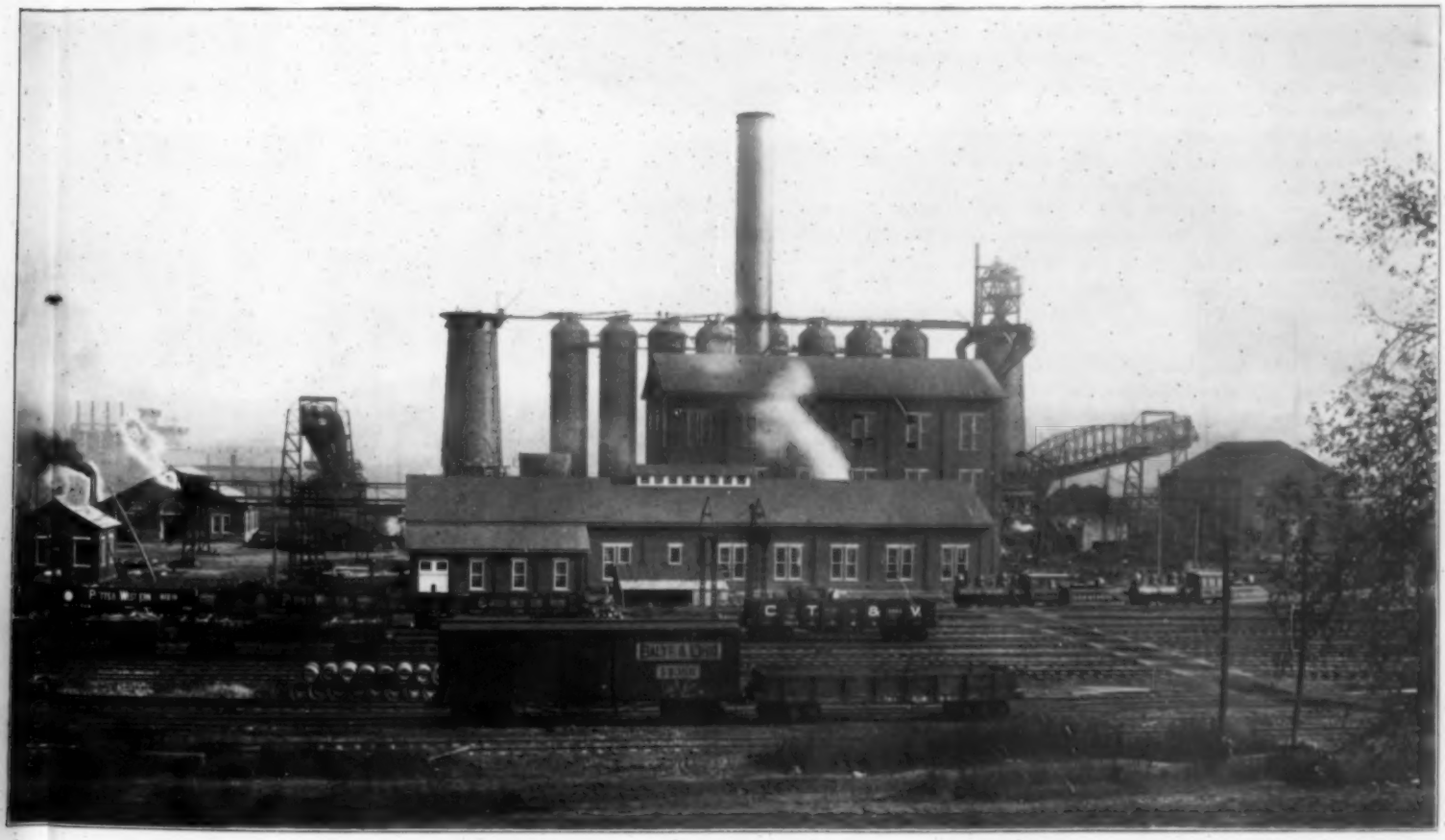

FIG. 4.—VIEW OF BLAST FURNACES AND BUILDINGS. RAILROAD TRACK SYSTEM IN FOREGROUND.

io Works of the National Steel Co., Youngstown, O.

THE IRON TRADE REVIEW

VOLUME XXXII. CLEVELAND, O. DECEMBER 21, 1899. CHICAGO, ILL. NUMBER 51

THE WEEK IN IRON CIRCLES.

THE MARKET AT LARGE.

With far more than the usual December activity, yet with a general quiet that is in marked contrast with conditions a few months ago, the iron trade comes to the end of this remarkable year. Production of pig iron is now at the rate of 15,000,000 tons a year; apparent consumption is substantially on the same level, still a trifle higher according to the figures for Dec. 1. We find nowhere any tangible signs of diminished consumption due to the present level of prices; but with every month consumers who have used up the material on their low-level contracts are coming to what seems a prodigious advance in their cost. They have seen the steady advance of the market but have not felt it. The decisions that will be made in the next two or three months in such cases will have much to do in determining the rate at which iron and steel will be absorbed in the second half of 1900. So far as the foundation material is concerned, it appears that ore buyers for the most part have contracted for supplies for 12 months ahead, and not to the opening of navigation in 1901. The pig iron situation has not changed; the forces seem so well balanced that at the moment a definite statement is difficult. In the East sales are made at prices recently prevalent, so that the seller assumes the freight advances effective Jan. 1. Sentimentally, the situation is easier; what this will come to will be tested by the January buying that is generally looked for. In the Central West the latest transactions in Bessemer iron have been at the highest price and on some lots the equivalent of $25, Pittsburg, has been paid. The gap between Bessemer pig iron and steel is less than in the more active fall months, the former being higher and the latter slightly lower. Billet contracts for the first half could be made no doubt at $35 to $36, Central Western mill. In finished material the readjustments of prices are almost entirely in plates and sheets. On the former 2.35c, Pittsburg, has been shaded on bids on a 1,500-ton lot of ship plates for delivery at a Lake Erie yard; but in general 2.40c for tank and 2.50c to 2.60c for boiler steel is the Pittsburg basis. A firmer stand on sheets is in evidence in some markets, but this is not general. Structural material is quite active, and in the matter of deliveries this is the slowest line on the list. That high prices would conspicuously check demand here is a prophecy entirely discredited by the condition of the mills. We note a 5,000-ton contract in the Cleveland district; 10,000 tons closed in the Chicago district and an equal tonnage pending there. Rail buying continues, with good prospect of further purchases both on domestic and foreign account. A 20,000-ton contract has just been made by a Western road. Bars, both iron and steel, are in better demand than usual at this season, the long list of manufacturing consumers of this material being occupied to their full capacity. Recent sales of steel bars were at 2.25c, Pittsburg. Coke is working higher, current sales being at $3 for furnace and $3.50 for foundry at Connellsville ovens.

PITTSBURG.

OFFICE OF *The Iron Trade Review*.
705 PUBLICATION BUILDING, Dec. 20.

The market has continued dull in the past week, but there has not been as much weakness connected with the dullness as is ususally the case in December. Prices are better maintained, on account of the prospects of next year, and because the trade is in stronger hands than ever before. There is the usual run of small business, but in large lots and for extended deliveries producers are not making the concessions which buyers desire before they take hold. Still, the volume of business so far this month has been as large as is customary in December, it being remembered that last December was an exception to the rule, so that no comparison between the present month and last December is fair.

The most interesting matter in the market is the strike of ore handlers at he docks. Several furnaces have been run very close in the matter of ore supply in consequence, and there may be serious trouble unless the matter is settled this week, as it is expected it will be. The furnaces have stocks of ore on hand, but they are not properly assorted to make the desired mix. The railroads have been so busy this season that furnace stocks are not as large as usual at this time, and most of the ore to carry the furnaces over until the opening of lake navigation is at the docks.

The main feature of strength in the situation continues to be the way in which Bessemer iron is being cleaned up. The last large transaction was the purchase by the leading Pittsburg interest of 42,500 tons at $24, valley furnace, and sales of smaller quantities for earlier delivery have been made at silghtly higher figures, so that the position in this respect is very strong. As against this are the continued reports that the high prices are showing decided signs of curtailing consumption next year. Some of this talk may be due merely to the fact that consumers who have still been getting material cheap on old contracts object to beginning suddenly to pay much higher prices, and it may be in such cases that as the conditions are fully grasped the buyers will be more ready to pay the higher prices.

There have been no changes of consequence in prices during the week, sellers feeling that they may as well stay as they are, welcoming rather than otherwise an opportunity to catch up and make preparations for a good business next year. Some mills will shut down or run only part of their capacity, but production of finished material this month will probably be up to the average December.

PIG IRON.—There have been no large lots of Bessemer sold since the sale to the leading Pittsburg interest of 42,500 tons, about 12,000 tons of which was for delivery in the first two months of next year, and the balance equal deliveries in the four following months. The price paid was $24, valley furnace, which is from 50 cents to a dollar higher than a number of large lots were sold to leading steel interests within the past two months, so that Bessemer pig iron may be fairly said to have advanced steadily in price up to the present time. In the past week sales have been made aggregating about 15,000 tons, for delivery early next year, and some smaller lots have been sold for delivery this month. Most of this iron went to the second largest Pittsburg producer. The price paid was $25, Pittsburg, and nearly all this iron is to come from a Pittsburg furnace. Since the price for next year's iron advanced, there has been only a small spread between near and later deliveries. In some cases small lots for prompt shipment sold recently at higher than $25, Pittsburg,

one lot of a thousand or two thousand tons having brought $25.62½, Pittsburg, as the iron was needed very badly at that particular time. There has been considerable activity in foundry iron in the past week, mainly for nearby deliveries, but prices are unchanged. Gray forge is rather stronger in the valley than at last report, but at Pittsburg prices are unchanged. We quote the market as follows:

Bessemer, valley furnace	$24.00	to	$24 25
Bessemer, Pittsburg	25.00	to	25 25
No. 1 Foundry	23.75	to	24.00
No. 2 Foundry	23.00	to	23.25
No. 3 Foundry	22.25	to	22 50
Gray Forge, valley furnace	21.00	to	21.25
Gray Forge, Pittsburg	21.00	to	21.50

STEEL.—The steel market is very quiet and prices are largely nominal, being made only on small lots. There is considerable tonnage yet to be placed for the first of next year, but prospects are that nothing much will be done until say the middle of next month. We quote billets in small lots at $35 to $36, and sheet bars $36 to $37.

FERRO-MANGANESE.—We continue to quote ferro-manganese at $100 a ton for domestic 80 per cent.

RAILS AND TRACK MATERIAL.—A considerable tonnage of low priced rails will go over to next year. It is held that as these rails will go direct into consumption, and will help to fill the mills for next year, the fact is a favorable one for prices. Odd lots of rails are being sold now and then on the present basis. In track material there is a good demand, for the time of year, with no change in prices. We quote prices on rails and track material as follows: Rails, standard sections, over 200 tons, $35; 100 to 200 tons, $37; car lots, $38; less than car lots, $40; light rails, 25-pound, and less than 50-pound, $37, all f. o. b. mill, Pittsburg; track material—Spikes, 2.50c; track bolts, square heads, 3.60c; hexagon heads, 3.85c; splice bars 2.50c to 2.60c; links and pins, 3c to 10c.

BARS.—The market for both steel and iron bars is rather quiet, but prices are being pretty firmly held. Agricultural implement makers expect a larger business next year than they have had this year, which no doubt has helped to maintain the bar market. We quote steel bars at 2.25c, Pittsburg, full half extras. We quote iron bars at 2.15c for common and 2.40c for refined.

STRUCTURAL MATERIAL.—This market is in the same condition as reported last week, there being a fair demand for material for certain classes of work. We quote prices unchanged as follows: Beams and channels, 3 to 15 inches, 2.25c; 18 to 24 inches, 2.35c; tees 2.30c; zees, 2.25c; angles, 2.25c. Universal mill plates, 2.50c to 2.75c, according to delivery and size of order.

PIPES AND TUBES.—The market for pipes and tubes is unchanged from last week. There is a fair demand for the season. Prices remain as last quoted: Merchant pipe, 50 and two 10's for car-loads delivered within the specified territory; well casing, screw and socket joint, 37½; inserted joint, 32½, with an optional 5 per cent to dealers only; boiler tubes 1¼-inch to 1½-inch, 40 per cent off; 1¾-inch to 2½-inch, 50 per cent off for iron, and 55 per cent off for steel; 2¾-inch and larger, 52½ per cent off for iron and 55 per cent off for steel, with 5 per cent additional in carloads, less than carloads being f. o. b. mill.

PLATES.—The plate market has not yet shown any signs of decided strength and prices are as last quoted. For deliveries extending over a considerable period some mills are firmer in their figures than on business for delivery in the near future. The market continues to be held down by the comparatively low prices named on narrow plates. We quote prices as follows for either prompt or next year's delivery: Tank plate, under say 50 inches in width, 2.40c; over 50 inches, 2.50c; very wide plates, 2.60c; shell steel, 2.60c to 2.70c; flange 2.70c to 2.80c; and fire box 3¼c to 4c.

SHEETS.—There is no sign of any improvement in the sheet market. Buyers have been endeavoring to hammer down prices further, but without success, but there is very little demand. We quote No. 28 gauge sheets unchanged at 2.95c to 3c. Galvanized sheets are as last reported, 75 and 5 and 75 and 10 per cent off, with a 15-cent freight allowance.

SPELTER.—Spelter is unchanged from last week's figures. Prime wstern grades can be had at Pittsburg at from 4.70c to 4.15c.

OLD MATERIAL.—There is very little doing in old material. Deman ids small, but scrap is being accumulated and it is more likely that prices will go lower than that they will go higher. We quote prices this week nominally unchanged as follows, Pittsburg, gross tons, except where otherwise specified: New Bessemer melting stock, $26 to $27; basic open-hearth scrap, $28 to $30; steel rails, mixed lengths, $22 to $23; short lengths, $23 to $24; iron rails, $29 to $31; cast borings, $14 to $15, net tons; cast scrap, $18 to $20; No. 1 wrought scrap, $24 to $25, net tons; busheling scrap, $16 to $18, net tons.

COKE.—There is very little doing in the coke market. Production is fully maintained. Cars are somewhat more plentiful, but so much difficulty is experienced in moving them that shipments are not helped materially. We quote strictly Connelsville furnace coke at $2.75 to $3 and foundry coke at $3.25 to $3.50.

CHICAGO.

Office of The Iron Trade Review,
1522 MONADNOCK BLOCK, Dec. 20.

In most branches of the market the usual mid-winter dullness is on in full force. The demand for material is not large, and what inquiries are being received will hardly be closed this year. Shipments of all kinds of iron and steel are very large on old contracts, and would be larger if producers could get the material out faster and secure cars to make shipments. There is considerable business in sight for structural mills, most of it being hung up until labor difficulties are settled fully in this market, when it is expected it will go ahead.

PIG IRON.—There is very little change in the situation. The demand for either immediate or future shipment is not large, and will hardly increase until next month, when sellers look for a decided buying movement. There are a considerable number of buyers, both large and small, who have not placed all of their requirements for the first half of next year, and these will probably purchase during January. Sales last week were limited to small lots, no larger orders than 1,000 tons having been closed. The market is very firm, notwithstanding the present quietness and no signs of weakness are observable on the part of the furnaces. On the contrary, for such iron as can be sold for immediate delivery, or anything like it, advances of from 50 cents to $1 are being asked. Foundries continue to run full time, and are using all the iron the furnaces can get to them. Quotations are unchanged as follows:

Lake Sup. Charcoal	$25 50	@	$26 50	Southern Coke No. 3	$21 00	@ $22 00
Local Coke Fdy. No. 1	25 00	@	25 50	Southern No. 1 Soft	23 00	@ 24 00
Local Coke Fdy. No. 2	24 50	@	25 00	Southern No. 2 Soft	22 00	@ 23 00
Local Coke Fdy. No. 3	24 00	@	24 50	Southern Silveries	26 50	@ 27 00
Local Scotch Fdy. No. 1	25 00	@	25 50	Jackson Co. Silveries	32 00	@ 32 50
Local Scotch Fdy. No. 2	24 50	@	25 00	Ohio Strong Softeners	24 50	@ 25 00
Local Scotch Fdy. No. 3	24 00	@	24 50	Alabama Car Wheel	24 00	@ 26 00
Southern Coke No. 1	23 00	@	24 00	Malleable Bessemer	24 00	@ 25 00
Southern Coke No. 2	22 00	@	23 00	Coke Bessemer	25 00	@ 26 00

BARS.—The demand has been limited to comparatively small lots, and sales last week were not very large. There are some inquiries for larger quantities, but it is not likely this business will be closed until next month. Mills are firm, and are quoting both iron and steel bars at 2.35c to 2.50c, half extras, Chicago.

STRUCTURAL MATERIAL.—A sale of 10,000 tons of bridge material was made to a local bridge works, for work to be done on a Western trunk line. No other large contracts are reported, but small-lot business has been excellent, considering the season, and the local labor troubles. Several good sized contracts are in sight, and will likely be settled within a short time after the first of the year. Included among them are a warehouse, which will take about 2,000 tons of material, a new building for the Chicago National Bank, for which plans are to selected within a short time, and several buildings for the Northwestern University, at Evanston, Ill., for which the present plans require from 7,500 to 10,000 tons. Several other projects of large size are also being considered. Quotations are as follows: Beams, 15 inches and under, 2.40c; 18 inches and over, 2.50c; angles under three inches and over six inches, 2.50c; three inches to six inches 2.40c; sheared plates, 2.90c to 3.15c; universal plates, 2.80c to 3c; tees 2.45c; zees, 2.40c; small lots from store are quoted from ¼c to ½c higher.

PLATES.—The demand is somewhat better, although sales are not expected to increase before next month. The mills are quite a little firmer in their views, and while the general market has not advanced, some mills are asking higher prices than were current a week ago. Quotations are as follows:

Tank steel from store, 3.20c to 3.40c. Mill shipments, Chicago delivery: Tank steel, 2.90c; shell, 3.10c; flange, 3.15c; marine 3.30c; fire box, 4c to 6c, according to brand.

MERCHANT STEEL.—There is very little new business in sight, but shipments on old contracts are large. Dealers are looking forward to a good January business. Smooth finish tire steel is quoted 2.80c to 3c; smooth finish machinery steel, 2.95c to 3.05c; spring steel, 3 65c to 3.75c; tool steel, 7c to 7.50c; special, 13.50c and upwards.

MERCHANT PIPE.—There is very little doing in this market, and it is not likely there will be any increase in transactions this month. Prices are unchanged at 50 and two 10's off for mill shipment on large orders, and 50 and 10 and 5 off on small orders.

SHEETS.—There is a much better demand, and several quite good sales were made in the week, with others to follow soon. The market has stiffened materially, especially on galvanized sheets, which are now quoted at 70 and 10. No. 27 black sheets are quoted at 3c to 3.20c, Chicago.

BILLETS AND RODS.—The local mills are still out of the market, and what business has been offered has gone to the outside mills. Bessemer billets are worth about $37, and open-hearth $45. There is no quotation on rods.

RAILS AND TRACK SUPPLIES.—A Western trunk line is reported to have placed a contract for about 20,000 tons of standard section rails, but aside from this little business was done in either light or heavy sections. The general demand is for only small quantities. Quotations are as follows: Rails, standard sections, $35 to $38; light sections, $37 to $42; splice bars, 2.50c to 2 70c; spikes, 2.75c to 2.85c; track bolts, 3 65c to 3.85c.

WIRE AND WIRE NAILS.—The demand is naturally light at this time of the year, but sales have been gratifyingly good, considering the season. No changes have been made in quotations. Makers quote single carloads of wire nails at $3.25 f. o. b. Chicago, and $3.35 for less than carloads. On wire current quotations are as follows: Plain annealed wire, $3.10; painted barb wire, $3.70; galvanized barb wire, $3.85.

OLD MATERIAL.—Stocks of scrap have increased considerably in the past week, and buyers are not pressing so hard to supply their needs. The market is strong, however, as dealers are very firm in their views, and are making no concessions. The demand is fairly good, in small lots. Dealers' selling prices are about as follows:

Old iron rails, gross,	$26 00@$27 00	Country malleable	$15 00@$16 00
Old steel rails, long, gr.	24 50@ 25 50	Iron axles, net	28 00@29 00
Old steel rails, mixed	20 50@ 21 50	Cast borings, net	10 00@11 00
Relaying rails, gross	30 00@ 31 00	Wrought turnings, net	11 00@12 00
Old wheels, gross	22 50	Iron axle turnings, net	13 00@14 00
Railroad forge, net	25 00@ 26 00	Steel axle turnings	12 00@12 50
Dealer's forge, net	16 50@ 17 00	Mixed country steel, gr	15 00
No. 1 cut mill, net	14 00@ 15 00	Stove plates, net	10 00@10 50
Heavy cast, net	14 50@ 15 00	Heavy melting steel, gr	19 00@20 00
Railway malleable, net	16 00	Old iron splice b., net	27 00

CLEVELAND.

OFFICE OF *The Iron Trade Review*,
27 VINCENT ST., Dec. 20.

After a week of selling, ore transactions for 1900 are about completed—that is, buyers appear to have gone as far in their engagements as they care to do at this early day. It is estimated that 75 to 80 per cent of the merchant ore from old-range properties has been taken up. In a good many instances buyers have contracted for only such ore as they will need up to Jan. 1, 1901, preferring to know what the pig iron market is likely to do in the second half of next year before making up their minds to pay the present price for ore for the early months of 1901. The consideration is not that the price of ore will change, but not every furnaceman knows whether conditions will be such in the first half of 1901 that the product of his furnace will be needed, and there are some who prefer to be on the safe side.

Boats were loaded with ore at Escanaba on Tuesday of this week and two are now on the way up that expect to take return cargoes from that dock. Official figures for this season's shipments still lack returns from Two Harbors, Gladstone and Escanaba, but it is evident that with rail shipments the total will go above 18,000,000 tons.

PIG IRON.—Though not as active as in December of last year the pig iron market shows more than the average December buying. The commonest fact in the situation is that furnaces are behind on deliveries. Foundries may not be melting iron up to their calculations; but if they are, and furnaces were up with their contracts there would be a considerable stock of iron in foundry yards. As a matter of fact foundries have very little iron on hand and there are sales every week to make up for shipments contracted for but delayed. Prices are strong and unchanged on foundry grades. In gray forge some business has been done at $21 to $21.25, delivered at valley mill. The sales of Bessemer iron to the leading Pittsburg interest at $24, valley, heretofore noted, have disposed of the valley Bessemer from first hands to July 1, but there has been some business through re-sales. One 5,000-ton block has been sold by the original purchaser at about 50 per cent above the price at which the iron was contracted early in the year, bringing above $24 at the furnace. We quote:

Bessemer	$24 90	Valley Scotch No. 1	$23 00@23 50
No. 1 Strong Foundry	23 00@ 23 50	Valley Scotch No. 2	22 50@23 50
No. 2 Strong Foundry	22 50@ 23 00	Gray Forge, valley	21 00@21 25
No. 3 Foundry	21 50@ 22 00	Lake Superior Charcoal	25 00@26 00

FINISHED MATERIAL.—A 5,000-ton contract for bridge material for Northern Ohio works has been closed in the week, and the reports from structural mills indicate that far from demand upon them being checked by present prices, the mills are less able to make reasonably early deliveries than in any other line. The probability of an early advance has been hinted at, but action is yet to be taken. Plates continue low and irregular. Some competition for a 1,500-ton ship plate contract has developed, and it is understood that a price between 2 30c and 2.35c, Pittsburg, has been quoted. On recent boiler steel business 2.50c to 2.60c, Pittsburg has been the range. The sheet market is firmer or unchanged according to the mill quoting. From 2.85c to 2.90c, Pittsburg, for No. 27 has been named on recent business, the lower figure being common. Galvanized sheets are quoted 75 and 10 to 75 and 5. Business in steel bars, deliveries in the next two months, has been done at 2.25c, Pittsburg; yet higher quotations are made by mills better filled. Bar iron in carload lots is unchanged at 2.15c, valley mill, half extras.

OLD MATERIAL.—The market is without incident. The accumulation of the cheaper grades of scrap is noticeable and until this is worked off prices may be somewhat lower. We quote No. 1 railroad wrought scrap at $24 to $25; machinery cast scrap, $17 to $17.50; wrought turnings, $14; cast borings, $12 to $13.

CINCINNATI.

Dec. 19.

Rogers, Brown & Co. say of the current market in pig iron: "There has been no change in the conditions that prevailed at our last writing. The demand is not as heavy as a month or two ago, but it is greater than the normal at this period of the year. The inclement season upon us does not seem to retard consumption, or chill the ardor of the prosperous foundrymen and manufacturers. The furnaces have been able to reach the mark of 15,000,000 gross tons annual production. Warrant yard stocks have been reduced to 9,300 tons. The aggregate furnace and warrant stocks, December 1, show that consumption is still in the lead. Charcoal irons are in unusual demand and chilling grades of Southern make are not obtainable, the leading furnaces being sold up for six months or more on all the high numbers. The Cherokee furnace will resume blast about Jan. 1 prox. and relieve the situation somewhat, as it will produce car wheel iron. The Southern furnaces are making fine records as to product in quantity and quality, but cannot keep pace with the demand. Requests for anticipated deliveries have to be declined, as most all the furnaces continue far behind contract dates of shipments. The scarcity of coke occasions consumers as much annoyance as the shortage of pig iron."

"It is an easy matter to tell the story of the iron market during the past few days," Matthew Addy & Co., say, "for it has been very quiet, as is seasonable. December, 1898, was a good December in the way of tonnage, but our record for the prevous five years showed that December was marked by the smallest sales of any month in those years. However, when we say that business is quiet, we do not mean that it is stagnant or there is any weakness anywhere. There is a fair run of orders right along and full prices are being obtaind without any difficulty. In fact, the main question seems to be the ability of the seller to guarantee delivery on time."

We quote for cash f. o. b. Cincinnati: Southern coke No. 1 foundry, $21.75 to $22.25; Southern coke No. 2 foundry,

$20.75 to $21.25; No. 3 foundry, $19.75 to $20.25; No. 4 and gray forge, $19.25 to $19.75; No. 1 soft, $21.75 to $22.25; No. 2 soft, $20.75 to $21.25; Lake Superior coke, No. 1, $24 to $24 50; No. 2, $23.50 to $24; Hanging Rock charcoal, No. 1, $25 to $26; Jackson county silvery, No. 1, $30 to $31; standard Georgia car wheel, $24.75 to $25.75; Lake Superior charcoal, $25.50 to $26.50.

PHILADELPHIA.

Dec. 19.

Some sellers of pig iron are making concessions to the extent of assuming the advance in freight rates effective Jan. 1. There is no considerable buying, though a good many inquiries are in and orders for 1,000-ton lots and less have been placed. Indications are that another buying movement will be seen in January. As a rule developments are being awaited. The enormous production of pig iron, now at the rate of 15,000,000 tons a year is the influential fact with many, as pointing to a possible easing of prices. With others the prime consideration is that consumption should have reached such a rate, with no sign of diminution. Dec. 1 statistics indicate that production and consumption are almost balanced, the reported reduction in stocks in November being about 8 000 tons taken from warrant yards, stocks in makers' hands remaining the same. While plenty of iron for future delivery can be had at quoted prices, there is no pressure to sell. We quote No. 1 foundry, standard brands, at $25 10 $25.50; No. 2X foundry, $23 25 to $24.25; No. 2 plain, $22 25 to $22.75; gray forge, standard brands, $20.50 to $21. In a few cases melters of iron are asking for the holding up of deliveries, wishing to have as small stocks as possible at inventory, but all such expect to have the amounts made up in January shipments. The halt over purchases of steel billets for next year continues. We quote $36 to $38. Considerable purchases are to be made but buyers want to do better than these figures. The outcome will not much longer be deferred now. Easy conditions in respect to prices and deliveries of finished material continue. There is a well established minimum but it is quite below the figures of two months ago, particularly on plates and sheets. Bars are in good demand. We quote 2.10c to 2.15c for refined iron and 2.50c for steel. Tank plates are quoted 2.50c to 2.60c and Eastern mills are still bidding on Western business on a lower basis than this. Structural material is firm and well sold ahead. We quote beams and channels at 2.40c to 2 75c, according to widths; angles, 2.40c to 2 60c. The old material market is easier. There appears an accumulation of common grades and until this is moved prices will not improve. We quote choice railroad scrap at $24 to $25; No. 1 yard scrap at $20 to $21 50; machinery cast at $18 to $19; wrought turnings, $15 75 to $16 25; cast borings, $14.50 to $15.

Pittsburg Foundrymen's Association.

The Pittsburg Foundrymen's Association held its monthly meeting last Monday night, a week earlier than the usual time. An address was given by Charles V. Slocum on "Casting Brake Shoes and Other Things." Mr. Slocum pointed out the fallacy of trying to make a brake shoe that would last a long time, because the harder the shoe the harder it is on the wheel, which is much the more expensive of the two. A soft gray iron brake shoe will wear out quicker and will heat the wheel less than one with a chilled surface, such as has been put on the market. The talk was followed by a general discussion of the subject of brake shoes and car wheels which became very interesting at times. The United States is far ahead of other countries in the manufacture of car wheels, and has lately exported considerable quantities to England and the continent. In France there is a law against the employment of cast iron wheels and they cannot in consequence be used on the government railways, but in cases where they can be used their employment is increasing. A great many wrought iron wheels are made in Europe. They do not wear long, but their life is longer than it would be on American railways because the service is not so severe as it is here. A member created some astonishment in the discussion by stating that the Pennsylvania railroad was getting brake shoes at 1¼ cents a pound, but later added that the contract was to run out this month. The meeting was very interesting, and was well attended.

INDUSTRIAL NOTES.

The J. H. Wagner Co., Vernon, Ind., has been incorporated to operate a machine shop, capital stock, $40,000. Directors, John H., Irba S., Everett and Chapin Wagner.

Coats & Corlett, Aurora, Ill., are in the market for a power drop hammer and power blacksmith forge. State make, weight of hammer, and price in writing them.

The Kentucky Fire Brick Works, Firebrick, Ky., will buy a second hand wet pan for grinding fire clay; either wooden or iron frame.

The Atlantic Iron & Steel Co., capital $10,000,000, has been incorporated in New Jersey to mine, produce and manufacture iron and steel, by Charles A. Porter, Kennedy Crossman, L. S. Filbert, William C. Martin, John P. Peddler, all of Camden.

The Enterprise Mfg. Co. Columbiana, O., is preparing to build a new foundry.

The Globe Steel Range Co., Kokomo, Ind., will begin the erection of new shops.

At Marshalltown, Ia., plans have been prepared for a 1½-story brick foundry, 66x77, for A. E. Shortill Co., to cost $3,000.

Henry H. Walker, Chicago, has begun the erection of a stove foundry, 60x100 feet, at 904-10 S. Rockwell st.

The West Virginia Steel Co., successor to the Caldwell & Peterson Mfg. Co., Wheeling, W. Va., has begun work on the largest building in its new plant. It will be 100x200. A second building will be 75x100 feet.

For the proposed Lockport Iron & Steel Co. project lots are selling at $350 each, with $300 worth of preferred stock with each lot. Citizens are asked to buy 2,000 lots and an equal number will be taken by outside capital. J. H. Hardebeck, of Illinois, is promoter, and it is the structural steel rolling process of E. M. Butz, of Pittsburg, that it is proposed to employ.

Colorado Fuel & Iron reports for October show net earnings of $192,848, an increase of $121,063, or 171 per cent, and for four months $574,182 net, increase $331,127, or 132 per cent. Fixed charges for 12 monhs ended June 30, 1900, including bonds, interests, taxes and preferred stock dividends amount to $600,000, or only $25,818 more than the net earnings for the first four months of the fiscal year. The company is in arrears on preferred dividends 34 per cent on $2,000,000.

The Union Steel & Chain Co. has ordered improvements for its furnace at Big Stone Gap,, Va., which is to be put in blast.

The Union Pacific machine shops at Green River, Wyo., burned Dec. 6; loss, $10,000. They will be rebuilt.

The American Tin Plate Co. is being hampered in its enlargement of the plant at Monessen, Pa., by the scarcity of carpenters.

The Monessen (Pa.) Foundry & Machine Co. is enlarging its plant.

A Weimer blowing engine has been installed at the Spearman Iron Co.'s furnace, Sharpsville, Pa. A local paper reports that the furnace company was offered $50,000 for the engine by another furnace company or three times its cost.

At Bridgeton, N. J., the plant of the Cumberland Nail & Iron Co. was sold Dec. 9, at master's sale and bid in by Frank M. Riley, trustee for the first mortgage bondholders for $75,000. The plant may be started again.

On Jan. 1, 1900, 27 blast furnaces lined throughout with fire brick made by the Kentucky Fire Brick Works, of Firebrick, Ky., will be in blast. The plant at Firebrick, while very old and of established reputation for its products, has been kept modern by the addition each year of any features calculated to improve the quality of the product or make it of more service to buyers. It is one of the largest fire brick plants in the United States and is located in the midst of several thousand acres of Kentucky flint clays owned by the company.

The plant of Marland, Neely & Co., of Pittsburg, recently destroyed by fire, has been replaced by a steel frame structure covered with corrugated iron, designed and erected by Wm. B. Scaife & Sons, of Pittsburg. The building was completed within 40 days after the contract was awarded.

THE SELLING SIDE OF THE TRADE.

Representatives of Well Known Iron and Steel and Equipment Firms.

W. W. Backman, whose picture we present this week, was born in Ohio. For a number of years he was in the pork packing business, in Cincinnati, then the center of that industry. During the great iron boom of 1879 and 1880 he began his career in the pig iron business in the employ of E. L. Harper & Co., in Cincinnati. Later he removed to Chicago, where he represented Rogers, Brown & Co. In 1891 he became a member of the firm of Forster, Backman & Hawes, sales agents of the Iroquois Furnace Co. In 1893 he started

W. W. BACKMAN.

in business for himself and has so continued ever since. At present he is selling the Dayton pig iron, made by the Dayton Coal & Iron Co., with offices in the Ellsworth Bldg., 355 Dearborn st., Chicago.

The Pittsburg District.

Plans for the new shops of the Union Switch & Signal Co., at Swissvale, Pa., were submitted to bidders last week. They will cover ground 562x304 feet. The total cost of buildings will be $250,000, and $100,000 worth of new machinery will be installed.

The Columbia Iron & Steel Co., Pittsburg, already mentioned, applied for a charter Wednesday of this week, the incorporators being Sibbet Macrum, George P. Loomis, Charles A. Robb, William E. Brown and C. C. Lee. A plant for the manufacture of both iron and steel castings will be erected at 34th st. and the Allegheny Valley railroad, Pittsburg.

The P. Wall Mfg. Co., Allegheny City, Pa., will erect a plant near its present plant on Preble ave., for the treatment of tin plate clippings. The tin will be regained by a combined electrical and chemical process, while the steel sheet scrap will be baled for use in open-hearth steel making. A large amount of tin plate scrap has been contracted for.

The Keystone Bridge Works, Pittsburg, will ship on Christmas what is stated to be the largest girder in the world. It is 135 feet long and weighs 65 tons. It requires four gun cars, with two flat cars between, to transport it, swivels being used.

It is stated that H. C. Frick has closed a deal for the purchase of 160 acres of land at Blair Station, up the Monongahela river from Pittsburg, for $113,000, being part of a 400-acre tract of land placed under option recently.

The charter of the Duquesne Steel Foundry Co., Pittsburg, has been granted. A steel casting plant will be erected on a 15-acre tract of land at Coraopolis, about 10 miles down the Ohio from Pittsburg. The incorporators are Thomas Rodd, chief engineer of the Pennsylvania Co., Edward Kneeland, of the Frank-Kneeland Machine Co., W. A. Herron, formerly of the Lewis Foundry & Machine Co., A. W. Herron, and T. H. Bakewell.

Thomas McNally, a Pittsburg contractor, has a contract for the erection of 400 coke ovens at Footedale, near Uniontown, for the Eureka Fuel Co., of Chicago. The contract involves about $200,000. It is to be filled by July 1 next.

The Davies Casting Machine Co., of Pittsburg, has been incorporated under Delaware laws with $25,000 capital. The plant will be at Sharpsville, Pa.

THE WEEK IN IRON AND STEEL STOCKS.

Denison, Prior & Co. say in their weekly iron and steel letter: "The week's market culminated in the wildest panic that has been seen on the stock exchange in many years. Stocks were sold at prices almost beyond comprehension. The good, as is usually the case, suffered with the bad, and there was a sweeping decline through the list. Relief came to the market on Tuesday from the action of Secretary Gage in increasing the Government deposits in the New York banks, and the concerted action of the New York Clearing House banks in pooling their resources and making loans at the legal rate on the stock exchange.

"The break in prices brought about a large amount of investment buying, which had the effect of steadying the market. The mere fact that the monetary stringency throughout the world has brought about this condition in the various security markets of the world, is no reason for saying that the value has dropped out of our better iron and steel stocks. The intrinsic merit is still there. Purchases made on this decline with the proper regard for the condition of the properties and the earnings that they are making cannot fail to bring profitable results to the purchasers. While there is absolutely no sign of a rampant bull market in sight, we feel that there should be a marked improvement from the present level of quotations."

Fluctuations of the Week and the Year.

The following table shows the fluctuations in iron and steel stocks for the week ending Dec. 18:

Name.	WEEK.				YEAR.			
	Open	High	Low	Close	High.		Low.	
Am. Car & Fdy.....	14¼	14¾	11½	11⅝	27⅜	May 25	11¼	Dec. 18
Am. Car & Fdy pr.	58	59⅝	56¼	57	68¾	Sept. 7	56¾	June 16
Am. Steel & Wire..	38½	40	32	34½	72	May 4	32	Dec. 18
AmSteel & Wire pr	90	91¾	85	85	106¾	Mar. 13	85	Dec. 18
Am. Steel Hoop.....	41¼	43	38	39	48⅜	Nov. 29	24	May 24
Am. Steel Hoop pr	75⅜	85	76	78	86¾	Sept. 14	70	May 13
Am. Tin Plate.....	20	27½	20	24	52¾	April 4	20	Dec. 11
Am. Tin Plate pr..	74¼	78	74¾	75	99⅜	Feb. 8	74¼	Dec. 11
Col. Fuel & Iron...	47	47	35½	37	64	Sept. 11	30¾	Feb. 8
Federal Steel.....	55½	57⅜	37	45	75	Apr. 3	37	Dec. 18
Federal Steel pr....	76½	79¾	70	71	93¾	April 3	70	Dec. 18
National Steel.....	40¾	40½	30⅜	33	63	April 24	30½	Dec. 18
National Steel pr..	89⅜	92⅜	89	89	99¾	Aug. 11	85	May 15
Pressed Steel Car..	54	57	50	50	61	Aug. 14	44¾	June 1
PressedSteelCar pr	84½	87¾	75	75	91	Sept. 7	75	Dec. 18
Republic Steel	19⅜	21	16½	16⅝	33⅜	Sept. 6	16½	Dec. 18
Republic Steel pr..	66½	68	62¾	63	79	Aug. 29	62½	Dec. 18
Tenn. Coal & Iron	100½	100½	64	70	126	Sept 11	36	Jan. 14

Notes.

The directors of the American Steel & Wire Co. have declared the regular quarterly dividend of 1¾ per cent on preferred stock, payable Jan. 2.

The Pressed Steel Car Co. has declared the quarterly dividend of 1¾ per cent on the preferred stock.

The Federal Steel Co. directors decided at last week's meeting to begin paying dividends on the common stock immediately after the close of the fiscal year. It is expected therefore that at the January meeting the directors will declare dividends of 3¾ per cent on the common stock, being at the rate of 5 per cent for nine months. The stock will then be put on a regular 5 per cent dividend basis and quarterly dividends of 1¼ per cent will be declared on the preferred and 1¼ per cent on the common. It was announced that the company had estimated earnings which would indicate that in the year ending on Dec. 31 the profits would be sufficient to pay the full dividend on the preferred, and on the common stock after reserving to the constituent companies upwards of $4,000,000.

THE IRON TRADE REVIEW
AND
INDUSTRIAL WORLD.

DEVOTED TO MACHINERY, METAL-WORKING AND FOUNDRY TRADES AND IRON AND STEEL MANUFACTURE.

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THE STOCK MARKET AS A FACTOR.

Persons in the iron trade need to remind themselves, after noting the course of well-known iron and steel stocks in Wall Street the past week, that their industry is in a condition of prosperity unequaled in years. The best steel stocks, those moderately good and those not so good intrinsically fell rapidly, and holders were eager to part with securities in many cases at 15 to 20 points below values that would not have been any temptation to sell a few weeks ago. It is noteworthy that steel stocks looked upon as attractive investments by men in the trade well informed concerning their earning power and the status of the properties back of them, have gone down quite below the basis of the underwriting. Nearly all the common stocks touched figures less than half the high point of last spring. With every week the large iron and steel consolidations are realizing larger profits on the material billed from their mills, as the lower priced contracts are worked off; yet the general trend of their stocks for some weeks has been downward. Stock values have now reached a basis on which from 8 to 12 per cent a year would be realized from investments in preferred stocks that will pay their dividends year in and year out in any but extreme panic times, and some even then.

Temporary causes in an unusual combination have produced the condition existing. It is entirely true and well understood that Monday's was purely a Wall Street panic; but it is a question at the same time whether that does not mean more than it did before certain industrial stocks representing hundreds of millions of capitalization began to be traded in on the stock exchange. More eyes are on stock quotations today than ever. At no time have so many business men and manufacturers been interested in the fluctuations of securities. In view of this fact is it not likely that Wall Street influences will have more effect than ever upon the decisions and policy of manufacturers in important lines? Manufacturers of the old school who have exchanged their stocks in local companies for consolidation stocks are doubtless having strange experiences with the shifting of values over night. It is a new sensation with most of them to have the market value of their investments fluctuate by tens or hundreds of thousands within 24 hours. It cannot but be true that after such a week of shrinkage as has just passed, the views of these men concerning a new enterprise or a proposed move in their own business would be tinged with the prevailing hue of the street, and that in spite of the fact that earnings might be on a scale never greater. Reassure themselves as they will concerning the separateness of Wall Street from ordinary business, owners of industrial capital would much prefer to have the stock market in harmony with conditions in the manufacturing world.

In general it is to be said that the iron and steel consolidations have been handled thus far with a commendable disregard of what Wall Street might say or do. Much has been written in financial columns about the common stocks of the steel companies, and statements have been plentiful as to the large earnings in excess of the dividend requirements on the preferred stocks. We have reason to believe that most of the statements have been quite within the truth. More could be said than has been said, too, about the ample cash assets with which these consolidations all started. But there has been no disposition in the case of most of the steel companies to make dividend distirbutions for the sake of affecting stock market values. The policy appears to be—and it is sound policy—to use part of the earnings of this time of unparalleled prosperity, in modernizing plants and providing equipment that will give the lowest attainable cost, in securing ore and coking coal properties, and in making sure against the day of lower prices and keener competition. This done, it is the policy of the most conservative of these companies to turn further earnings into surplus so that when dividends on the common stock begin they may be continued year after year. In other words part of the fruits of this period of unusual profits will be stored against the lean years that are to come.

If this policy shall be persisted in, the effect of such disturbances of values as have been seen the past week will be reduced to the minimum. Time will be needed for a full demonstration of the conservatism and soundness which have characterized iron and steel manufacture for the most part, in the period of its development in the individual and competitive form. If the controlling powers in the great iron and steel companies of today are seeking a career they can find no achievement more worthy their talent and their most resolute, persistent effort, than to place their securities where they belong, at the head of the industrial list. They will best succeed in this by trying to forget that Wall Street has an existence.

SOMETHING of the size of the investment required for a modern blast furnace plant, and of the engineering problems involved, may be gathered from the detailed description elsewhere in this issue, of

the new furnaces of the National Steel Co., at Youngstown, O. Some idea is given by the article of the increasing importance of the iron industry as a contributor to engineering and structural works and to manufacturers of electrical equipment. Every such advance as has been made in the last three years in blast furnace construction means larger employment of labor-displacing machinery and new problems for solution by mechanical and metallurgical engineers. Higher engine powers are demanded, improved devices for delivering from 2,000 to 2,500 tons of material at the top of a high furnace every 24 hours, and equipment for rapid and economical handling of ore in and out of vast stock yards. The practical working out of these problems is one of the most interesting features of the recent advance in American engineering, as related to iron and steel, and the interest in the subject fully warrants the prominence we have given it in this number.

OBITUARY.

James W. Reis.

James W. Reis, district manager of the National Steel Co., died at his home at New Castle, Dec. 17, aged 35 years. Death resulted from typhoid fever. Mr. Reis was one of the most competent blast furnace and steel works managers in the country. His judgment on mechanical and metallurgical propositions was sound and in a relatively brief career he had become a leader in latter day achievement in iron and steel manufacture. Before the formation of the National Steel Co. he had charge of the furnaces of the Shenango Valley Steel Co., and had brought their operations to a high state of efficiency. He belonged to a family of iron and steel works managers. He was a brother of Wm. E. Reis, president of the National Steel Co.; of John W. Reis, general furnace manager of the National Steel Co.; Geo. L. Reis, superintendent of the Bay View works of the Illinois Steel Co., and Jared Reis, of Philadelphia. Another brother, Edward Reis, who was connected with the New Castle works, died a few years ago.

Alexander M. Byers, Jr.

After an illness of four weeks of typhoid fever, Alexander M. Byers, Jr., oldest son of Alexander M. Byers, of A. M. Byers & Co., died at Pittsburg Dec. 16. Though but 27 years old, he had won recognition for business abilities. Graduating from Yale College in 1894, he went into business with his father and became vice-president and secretary of the company. He was also a director of the Iron City National Bank.

P. P. Lane.

Col. Philander P. Lane, one of the founders of the Lane & Bodley Co., of Cincinnati, and for 50 years a leading business man of Cincinnati, died in that city on Dec. 6, aged 78 years. He was born in Nassau, N. Y., in 1821, and seven years later his parents emigrated to Ohio. As a young man he found employment in the machine shop of Bill & Brother, at Cuyahoga Falls, O. He went to Cincinnati in 1848, and in 1850 opened a small shop on Pearl st. In 1852 he took into partnership with him Joseph T. Bodley, and thus was started the firm of Lane & Bodley. On going to war in 1861 he was made captain of his company and later became colonel of the 11th Ohio. Col. Lane took a great interest in education and was one of the founders of the Ohio Mechanic's Institute and Industrial Exposition. There are seven surviving children, including Mrs. C. F. Thompson, wife of the former secretary of the Lane & Bodley Co., and H. M. Lane.

THERE is now some doubt about the success of the deal to consolidate the machine chain manufacturers, which is due partly to the tightness of the money market. Options were secured on 13 plants, which were shut down recently to take inventories.

PERSONAL.

Charles A. Plamondon, vice-president of the Plamondon Mfg. Co., of Chicago, maker of power transmission machinery, was elected president of the Illinois Manufacturers' Association last week.

E. W. Beadel, of Cleveland, heretofore with the Wellman-Seaver Engineering Co., resigned to become chief engineer of the Pennsylvania Engineering Works, New Castle, Pa.

L. Ball, for several years secretary of the Buhl Malleable Co., at Detroit, has disposed of his interest in that company and has located at Northville, Mich., a suburb of Detroit, as sales agent for manufacturers and as commercial broker, under the name of L. B. Ball Commercial Co.

C. S. Robinson, for some months superintendent of the steel works of the Colorado Fuel & Iron Co., Pueblo, Col., has been advanced to the newly created office of general superintendent of the iron and steel departments and J. B. McKennan, formerly assistant superintendent, become superintendent in Mr. Robinson's place. R. H. Lee, who has been superintendent of the blast furnaces, for the past six months, has taken the position vacated by Mr. McKennan and Jacob Cambier, chief chemist, assumes control of the furnaces. Graham Robinson is made chief chemist. C. S. Robinson went to Pueblo in 1892, and took the position of superintendent of the blast furnaces. Later he was made assistant superintendent and when his brother, T. W. Robinson, became general manager of the Illinois Steel Co., succeeded him as superintendent. His new position includes the superintendency of iron mines and quarries.

It is reported at Pittsburg, but with no official confirmation, that Henry W. Oliver, president of the Oliver Iron Mining Co., is to become chairman of the Carnegie Steel Co., Ltd.

John Stevenson, Jr., of New Castle, is reported to have acquired a one-third interst in the recently formed Sharon Steel Co., which proposes to build a blast furnace and open-hearth steel plant.

George T. Oliver, of Pittsburg, the well-known iron and steel manufacturer, is spoken of in political circles as a probable candidate for the Republican nomination for Congressman-at-Large at the next State convnetion.

AT a meeting of the directors of the Republic Iron Co. held at the company's office, Wade Bldg., Cleveland, last week, a dividend of $2 a share was declared. As there are 100,000 shraes the distribution is $200,000. A dividend of $1 a share was paid in July and one of $1 in January, so that a total of $4 has been paid this year. The stock is now quoted at $17 to $18.

THE regular monthly meeting of the Engineers' Society of Western Pennsylvania was held Tuesday night at the house of the society in Pittsburg. The paper of the evening was by W. E. Snyder on "Mechanical Devices as Applied to Firing of Steam Boilers." The following were elected members of the society: F. Harding Beebe, William B. Miller, Guy D. Newton, and P. K. Slaymaker, all draughtsmen for Julian Kennedy, Pittsburg; Frederick McGoddard, electrician with George Westinghouse, Pittsburg; David P. Jones, consulting mechanical engineer, Stevenson Building, Pittsburg; Walter M. McLean, master mechanic with Pittsburg Plate Glass Co., and John G. Splane, manager Pittsburg department National Transit Co. Thursday evening the society will hold a smoker in its house, at which there will be music and other entertainments, and refreshments. The chemical section of the society will meet next Thursday evening.

AT Crown Point, Ind., last week Judge Gillett decided that a labor union has the lawful right to demand the discharge of a non-union workman and that the latter has no remedy at law for his discharge. The case was that of Walton against Lake Lodge No. 2, Amalgamated Association of Iron and Steel Workers. Walton was discharged by the Inland Forge & Iron Co., of East Chicago, Ind., on demand of the union. No charge of incompetency was preferred against him and his sole offense was not being a member of the union. He sued for $20,000 damages. He will appeal from the decision of Judge Gillett.

OUTPUT OF BLAST FURNACES OF UNITED STATES.*

December 1, 1899.

Location of Furnaces.	Coke and Anthracite.					Charcoal.				
	Total No. of Stacks.	In Blast.		Out of Blast.		Total No. of Stacks.	In Blast.		Out of Blast.	
		Number.	Weekly capacity.	Number.	Weekly capacity.		Number.	Weekly capacity.	Number.	Weekly capacity.
New York	13	6	7534	7	3650	2	2	200	0	0
New Jersey	6	4	2852	2	1200	.....	.....	.....	.....	.....
Spiegel	2	2	413	0	0	.....	.....	.....	.....	.....
Pennsylvania:						13	2	110	11	550
Lehigh Valley	28	21	10679	7	2930	.....	.....	.....	.....	.....
Spiegel	1	1	104	0	0	.....	.....	.....	.....	.....
Schuylkill Valley	14	11	8708	3	1739	.....	.....	.....	.....	.....
Upper Susqu. Val	5	4	3188	1	600	.....	.....	.....	.....	.....
Lower Susqu. Val	10	10	6092	0	0	.....	.....	.....	.....	.....
Lebanon Valley	13	11	8610	2	974	.....	.....	.....	.....	.....
Pittsburgh	29	29	67063	0	0	.....	.....	.....	.....	.....
Spiegel	1	1	1282	0	0	.....	.....	.....	.....	.....
Shenango Valley	15	14	18712	1	935	.....	.....	.....	.....	.....
West'n Pennsylvania	19	14	16777	5	2190	.....	.....	.....	.....	.....
Spiegel	1	1	429	0	0	.....	.....	.....	.....	.....
Maryland	4	3	5066	1	250	4	0	0	4	569
Spiegel	1	1	859	0	0	.....	.....	.....	.....	.....
Wheeling District	10	10	13820	0	0	.....	.....	.....	.....	.....
Ohio:						8	3	210	5	310
Mahoning Valley	14	12	19407	2	8000	.....	.....	.....	.....	.....
Central & Northern	11	10	17510	1	1000	.....	.....	.....	.....	.....
Hocking Valley	2	2	700	0	0	.....	.....	.....	.....	.....
Hanging Rock	12	9	4971	3	560	.....	.....	.....	.....	.....
Illinois	16	14	27032	2	3030	.....	.....	.....	.....	.....
Spiegel	1	1	749	0	0	.....	.....	.....	.....	.....
Minnesota	1	1	550	0	0	.....	.....	.....	.....	.....
Wisconsin	4	4	3420	0	0	.....	.....	.....	.....	.....
Missouri	2	1	501	1	500	.....	.....	.....	.....	.....
Colorado	2	1	1100	1	1000	.....	.....	.....	.....	.....
Virginia	21	16	10858	5	2798	4	1	49	3	290
Kentucky	5	4	2116	1	700	3	0	0	3	200
Alabama	38	23	19897	15	9400	7	3	700	4	600
Mich., Mo. and Wis.	.....	.....	.....	.....	.....	15	9	4045	6	2688
Tennessee	12	11	7864	1	400	6	4	1100	2	355
Georgia	2	0	0	2	960	3	1	430	2	300
North Carolina	2	1	285	1	400	.....	.....	.....	.....	.....
New England	.....	.....	.....	.....	.....	11	3	264	8	730
Texas	.....	.....	.....	.....	.....	4	2	403	2	600
Utah	.....	.....	.....	.....	.....	1	0	0	1	175
Oregon	.....	.....	.....	.....	.....	1	0	0	1	275
Totals	317	253	289448	64	43176	82	30	7511	52	7642

SUMMARY.

Fuel.	In Blast.					Out of Blast.			
	Number.			Weekly Capacity.			Number.	Weekly Capacity.	
		Month Previous.	Year Previous.		Month Previous.	Year Previous.		Month Previous.	
Charcoal	30	29	18	7,511	7,113	6,018	52	7,642	7,512
Coke and Anthracite	253	248	177	289,448	281,409	229,510	64	43,176	38,556
Total	283	277	195	296,959	288,522	235,528	116	50,818	46,068

*Condensed from the *Iron Age*.

Wage Advances at Jones & Laughlins Works.

Conferences are being held between Jones & Laughlins, Ltd., and their employes relative to the new scale of wages for next year. It will be remembered that this firm ceased to recognize the Amalgamated Association July 1, 1898, an individual scale with their employes going into effect on that date, to last for 18 months. A general advance is expected to all the employes. The scale for the Bessemer steel department has already been settled, the men receiving a 10 per cent advance in wages. On account of improvements now being made in the Bessemer steel department, by which the output will be considerably increased, the earnings of some of the men will increase beyond the straight 10 per cent.

Tin Plate Prices.

A statement has been made in some Pittsburg daily papers that the American Tin Plate Co. contemplates making "another 10 per cent advance in a few days." The statement is entirely incorrect. It is stated in the same connection that the company since its organization has advanced prices over 100 per cent. The price when the company took hold was $2.75 for 100-pound coke plates, while now it is $4.85, an advance of 69 per cent, instead of "over 100 per cent."

At Oberlin, Kas., the Oberlin Foundry & Machine Shop plant has just been completed.

75 YEARS OF IRON MANUFACTURE.*—III.

BY JOHN FRITZ.

I shall now return to the rolling mill. As already stated, with the introduction of the three-high mill in 1857, the commencement of the great improvement in rolling mills and machinery connected with them took place. The rolls were made larger in diameter, better fitted up, and a more powerful and a much better class of engines was introduced, larger and better heating furnaces were built, and many labor-saving devices were introduced. But with the marvellously increased production of Bessemer steel it was evident that a larger ingot must be used in order to prevent congestion in the pit furnaces and rolls. This, of course, involved the building of larger, heavier and more rapid working machinery.

Changes in Blooming Mill Construction.

In 1868 the lamented Holley, who later on became the consulting engineer of the Bessemer works and so remained until his death, and to whom the country is largely indebted for the introduction of the Bessemer process and for many improvements and important suggestions in the art, built a three-high blooming mill at Troy, N. Y. This mill had the top and bottom rolls stationary, the middle roll being moved up and down, to suit the work, by four screws passing through the bearing carrying the rolls. In the bearing there was a thread corresponding to the thread on the screws, which screws were driven by power. He also had lifting tables, front and back fitted with loose rolls, and the ingots were pushed into the rolls by hand both in front and in back.

In 1871 my brother George, then superintendent of the Cambria Works, built a three-high blooming mill in which the middle roll was stationary and the top and bottom ones movable, with feed tables both front and back, and the rollers driven by power taken from the train. He also introduced what is called a "pusher" to adjust the ingot in a proper position on the table and also an arrangement for moving the ingot on the table in proper position to enter the rolls. In 1872 we built at Bethlehem, Pa., a three high mill in which all the rolls were fixed, with table similar to those in Cambria, but driven by an independent power which very much simplified the arrangement of driving the tables. This is the plan of the mill that was generally adopted, and for a moderate sized ingot and quick working is probably the best plan of mill. But for heavy ingots and for variety of work the reversing mills are preferable. The rail trains are, with two exceptions, three-high, with larger rolls, very heavy housings and fittings, and more powerful engines, and generally some kind of labor-saving device attached to the rolls. In fact all the modern rail mills have introduced labor-saving machinery to such an extent that there is comparatively speaking but little left for man to do. This is to a great extent due to the introduction of steel, as it rarely either splits or cracks in rolling, while iron is very liable to do both, which renders the use of delicate automatic machinery more difficult in rolling iron than in rolling steel.

Many instructive, interesting, annoying and amusing incidents which might be related occurred in connection with the almost magical developments which took place in the manufacture of iron and steel during my long association with the business. But time will not permit.

We left the blast furnaces in 1840, which, as before mentioned, was the commencement of the use of mineral coal, from which period the greatly increased production commenced. While there was no practical change in the principle of making pig iron, yet, the continued increase in size of the furnace, the increased pressure and quantity of blast, the introduction of the Whitwell system of fire brick stoves, the better understanding of furnace working, the increased knowledge of the chemistry of pig iron making—all these, coupled with the indefatigable determination of the men in charge, have contributed to bring about the unprecedented and phenomenal production which has so amazed the iron makers of the world.

*An address delivered in Convention Hall, National Export Exposition, Philadelphia, at the celebration of the seventy-fifth anniversary of the Franklin Institute.

Advance in Steel Works Processes.

In 1868 the manufacture of acid open-hearth steel commenced; but its progress was slow, and following the Bessemer, this process not being so interesting and exciting, did not command the attention and respect to which it was entitled. The fact that the Bessemer was in the lead and the machinery was already in use, and that the knowledge of refractory material and in the handling of the steel was acquried, made the introduction of the open-hearth process easy compared to the Bessemer. But the fact that it quietly made its way into general use does not in any way detract from its great usefulness, and, with the invention and introduction of the "Thomas" basic process and its application to the Siemens-Martin open-hearth system, it takes rank only second to Bessemer as one of the greatest metallurgical inventions of the age. And taking into consideration the character of our ores and coal, and their geographical location, the superiority of the metal produced by this process, for structural and machine purposes, may cause it in the near future to outrank the Bessemer in value and general usefulness.

When we look back to the commencement of the last half of the present century, and take a thoughtful survey of all the inventions and improvements that have taken place in the arts of metallurgy during this period, the complete reversal of the position that iron and steel formerly held in relation to each other, the superiority of steel over iron in the useful arts, and the immensely increased production which is unparalleled in the history of metallurgy, it seems impossible to fully realize that so great a change could have taken place within so brief a time. While we have properly received great credit for the unprecedented developments we have made in the iron and steel industry in the United States, we must not forget that it was the inventions of Cort, of Mushet, of Bessemer, of Siemens, and of Thomas that enabled us to accomplish such important results; and to them all civilized nations owe a debt of gratitude for the incomparable blessing their inventions have conferred on society. Yet how few of us even for a moment think of the trials, troubles, disappointments, mental anxiety and bodily toil these men had to undergo in the perfection and introduction of their inventions, besides suffering the sneers and jibes of those who imagine that an inventor is nothing but a wild enthusiast, and treat him accordingly. The story of many inventors is truly pathetic and none more so than that of the lamented Thomas. The personal side of the story of the inventor of the basic process can only be appreciated by the reading of his life.

It should not be forgotten that England is the birthplace and home of the Iron and Steel Institute and much of our success is due to the information we have gained from the invaluable papers read at their meetings and the discussions that followed them. Here I wish to say that I would commit an act of ingratitude should I fail to give credit to the brave and noble workmen who, throughout my long connection with the business, have ever stood ready to meet any emergency, no matter what the danger or difficulty might be. All that needed to be said was, "Come boys," but never, "Go boys," and if the difficulties were not insurmountable, they were sure to be overcome; and too much credit cannot be given to these fearless and energetic men for the almost fabulous progress that has been made in the manufacture of iron and steel in this country.

An Old-Time Mill Scene.

When I look back to my early days in the iron business long, long ago, probably too long, it brings to mind one of the happiest periods of my life. After my daily labor was done I was free from all care until the next morning. After supper, at half-past six, then a simple meal, I returned to the works and helped the puddler, heater, or roller, as the case might be, until about 10 o'clock. At that time the practical men, puddlers, heaters and rollers, were generally Englishmen and Welshmen. After the heats were charged in the furnaces, and while waiting for the charges to become heated, they would get their pipe—"cutty" they called it—and sit down on a pile of pig or puddled iron, as happened to be most convenient, and take their smoke. Having gained their confidence, I would take a seat by them and then they would tell me about the works in England and describe how their mills were arranged, their system of rolling, the principle and construction of their puddling and heating furnaces, and how to work them. As I spent my nights in assisting them to puddle, heat and roll, I gained a very general practical knowledge of the manufacture of wrought iron, which soon became of great value to me; and to the nights spent in these works with the hearty and generous workmen I owe much of whatever success I may have attained in after life. For the kind and generous manner in which I was always treated by them they ever have a green spot in my memory. In comparing this happy period in my life with what I have since many times gone through, it might, with propriety, be compared with the "elysian fields."

How little do the younger men that now have charge of our great iron and steel industries know or even think of the severe mental strain, the great amount of bodily toil, the vexation, the surprises, and the disappointments that had to be endured by the men in charge during the erection and perfection of these vast establishments that are now engaged in the manufacture of iron and steel. And, gentlemen, let me here say that this great work was not accomplished by command, but by example. It was the men in training, before alluded to, who erected, perfected, and put in operation these most marvellous enterprises of the age. And to these noble, brave and energetic men the people of this country owe a debt of gratitude for the far-reaching results they so thoroughly accomplished, and which have already changed the social condition of our vast territory. They have furnished us with a material which for quality and cheapness and the quantity furnished in a given time is without parallel, and could not have been realized by any other known methods. Without it the building of trans-continental roads would have been almost impossible. Had the rails been made in the old way out of the puddled iron, and the increased traffic on the Atlantic ends of the lines, they would be worn out before the Pacific coast could have been reached. The credit does not end here. The reduction of freight rates, owing to the general use of steel rails, is so enormous that it has been intimated by one of our most distinguished public men that the saving alone on the cost of transportation due to the use of steel in the place of iron would, it available, amount to a sum sufficient to pay our national debt in a comparatively short time.

The Kingship of Steel.

In addition to the use of steel for rails, the Great West is being fenced with steel at a cost that seems almost fabulously cheap, and this product is being used largely for many other purposes. It was formerly iron that was used for structural work, now it is steel; and it has practically superseded the use of wrought iron. Steel is largely used in the construction of all grades of machinery employed in the manufacturing arts. It is the base of our immense inland system of transportation. It is the imperial metal that has enabled the engineer to perform the daring and remarkable engineering feats which he has accomplished during the last half of the century, without which they would have been practically impossible. It is the material used in the construction of these monster floating palaces that cross the vast ocean with the regularity of a railroad train.

Fifty years ago steel was a luxury to the engineer. Modern practice of steel-making in the hands of the mechanical engineer, the metallurgist and the chemist has wrought wonders in producing a material which is used alike in the manufacture of articles of the most weighty, the rudest and cheapest grades, and in the construction of the most intricate, the finest, and most delicate implements and machinery. And it is boldly asserting its value and importance through every walk of life.

It is to the invention, introduction and perfection of the modern system of steel-making in this country that we are indebted for the education of our people in the scientific, mechanical and metallurgical arts, which has enabled them to erect such manufacturing plants as were necessary to supply our government with the sinews of war, which made it possible to achieve those glorious victories which at once placed us in the front rank among the nations of the earth.

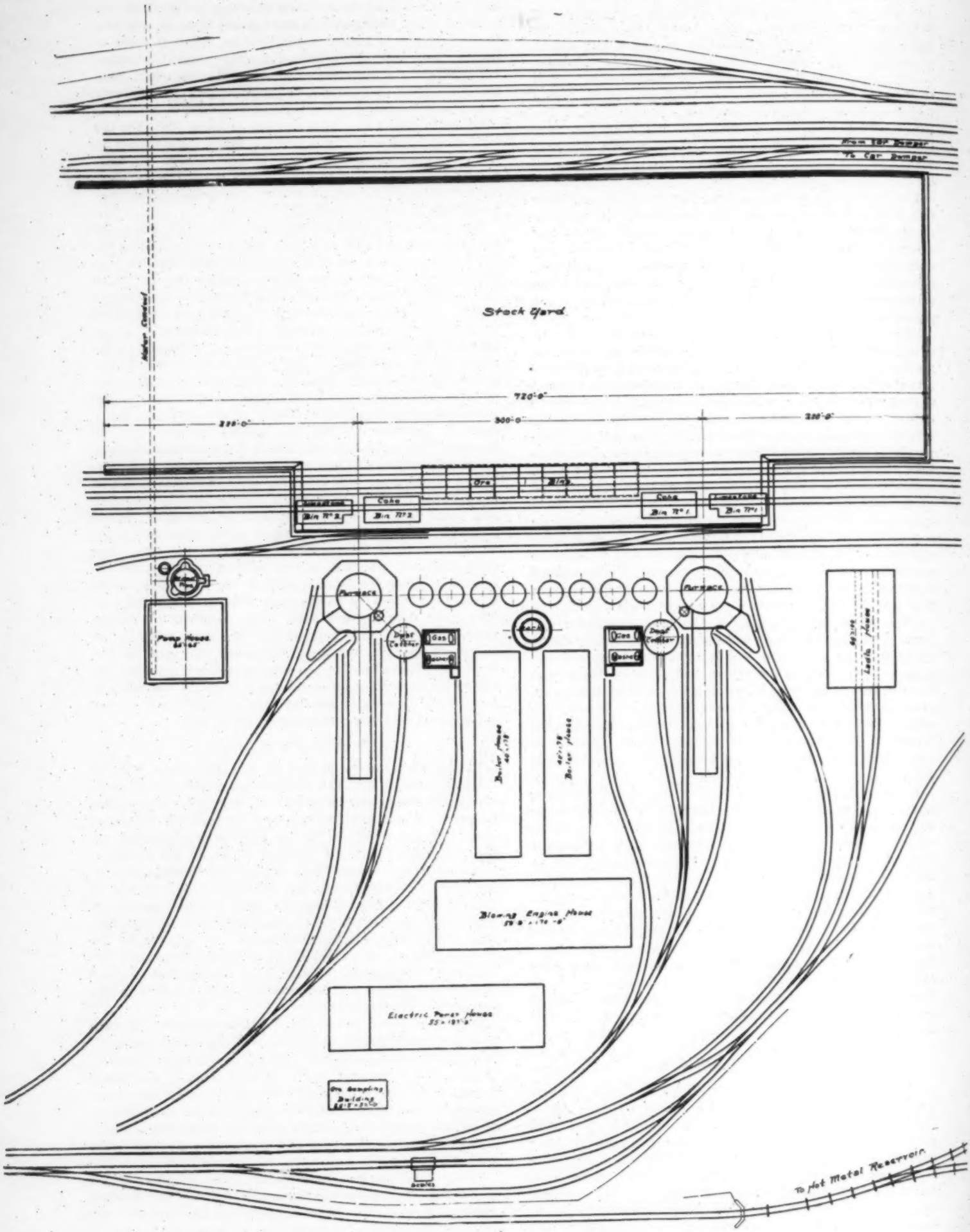


FIG. 5—BLAST FURNACES AT THE OHIO WORKS OF THE NATIONAL STEEL CO. PLAN VIEW.

The New Blast Furnaces at the Ohio Works of the National Steel Company.

(With Supplement.)

The third of Central Western blast furnace plants to center the interest and arouse the expectation of the iron trade of the country is nearing completion at the Youngstown, O., or Ohio Works of the National Steel Co. The new Duquesne furnace plant of three years ago, with its 100-ft. stacks and a promised output of 600 tons a day, was a veritable sensation in the year of its erection, and for months after the first two furnaces started the experts traveled up and down the comparative merits of big furnaces and moderate-sized furnaces, as solvents of the problem precipitated by the Mesabi range with its comminuted ores. The experience of nearly three years has not fulfilled all the promises made for the big furnaces in the handling of high percentages of the Mesabi product; but the Duquesne type has set the pattern for size. The two furnaces at Lorain were built 100 feet high, and the two at Youngstown have further disappointed the prophets of a return to moderate units. They have even exceeded Duquesne and Lorain in size, being 106 feet 6 inches high, and 23 feet in diameter at the bosh. Other furnaces under construction or projected by the large companies have taken the high stack as an established institution, for all aim at 600 to 700 tons output in 24 hours.

The two furnaces now nearly ready at Youngstown were begun in 1898 by the Ohio Steel Co. under the administration of Henry Wick as president and Wm. H. Baldwin as secretary, months before the consolidation of Central Western steel companies existed even as a dream. The steel plant which was started early in 1895 had been increasingly successful, both as to tonnage and the quality of its product. The centralizing process in the steel trade had brought significant developments. The policy of dependence for pig iron upon near-by furnaces, from a number of which the freight amounted to little more than the switching charge, had answered well in the years when furnacemen's and iron miners' profits were little or nothing. But new conditions demanded a measure of independence of both mining company and merchant furnace. Plans for two furnaces were decided upon and a beginning was made in a policy of ownership of ore supply, which later has been broadened steadily.

When the Ohio Steel Co.'s Bessemer plant was built about two miles northwest of the business center of Youngstown, land was secured also for the blast furnace plant which was then regarded a possibility; but very large additions to the original site have been made in the past few years, the holdings now consisting of nearly 300 acres.

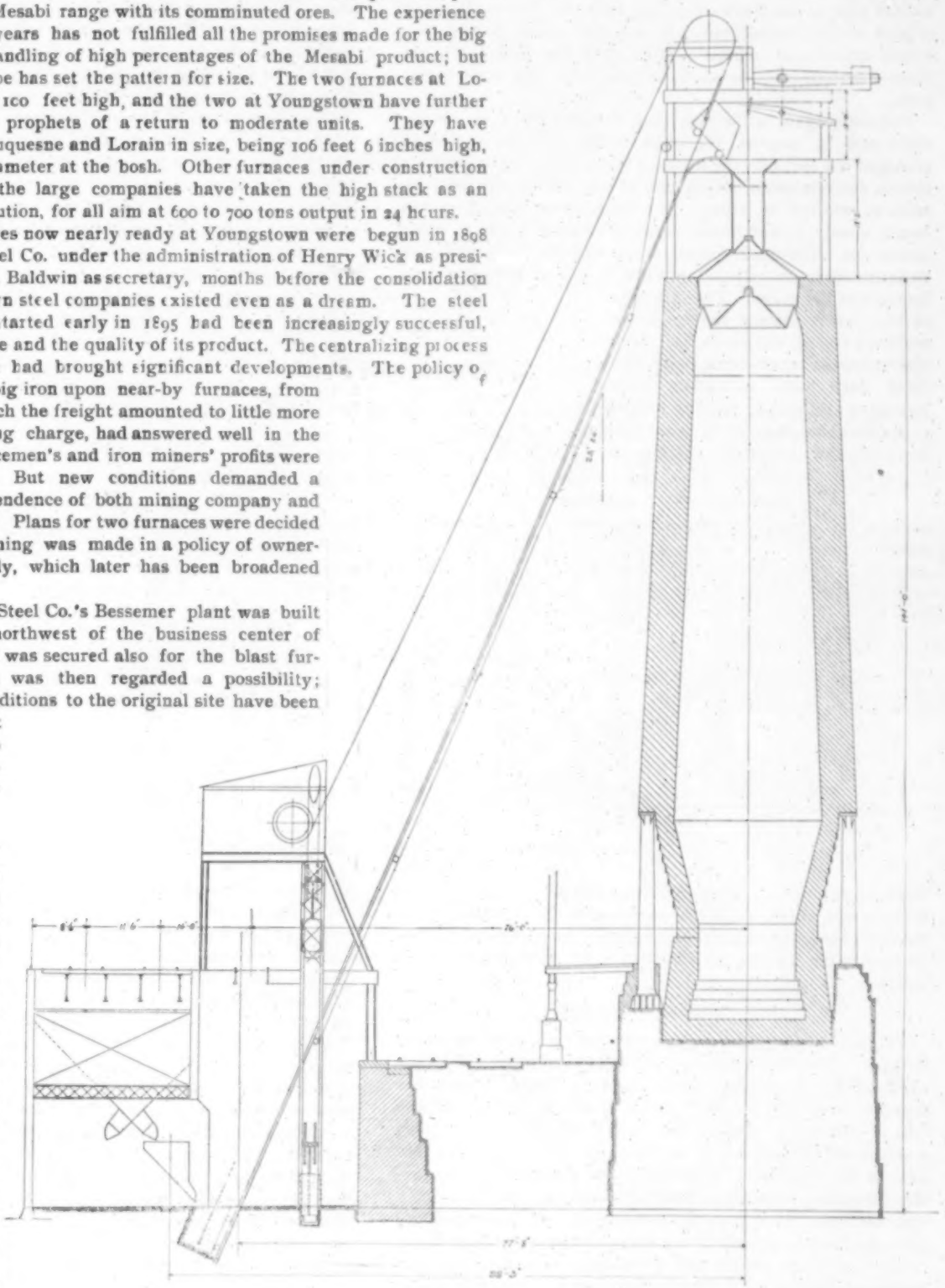


FIG. 6.—SECTION THROUGH FURNACE, HOIST TOWER, SKIP PIT AND BINS.

General Features.

The site of the furnaces, which is contiguous to that of the steel works and farther up the Mahoning River, was admirably adapted to the purpose. Very little preliminary work was necessary in connection with the ore stock yard, the rock which underlies most of the site being only lightly covered with earth. All that was required to secure a substantial floor was to grout and cement occasional depressions; and no piling was needed for the foundations of furnaces or buildings. The plan view in Fig. 5 shows the general arrangement of the plant. Two furnaces are now about completed, and work has begun on a third. A fourth will be added later, making two groups of two. The present description has to do with Furnaces Nos. 1 and 2 and their auxiliary plant.

The stock yard as laid out for the two furnaces is 720 feet long, with a width of 250 feet, measuring between the bridge rails.

Its walls are 36 feet high on the ore bin side and 24 feet high on the opposite, or transfer car side. Storage capacity is provided for 750,000 tons of ore, but with the extension of the stock yard 449 feet past Furnace No. 3, much more than the amount named can be stored. Provision is made so that no winter shipments of ore from Lake Erie docks would be necessary but for the fact that cars are not always available to take the ore direct from vessel in navigation time. The drainage of the stock yard is toward the bin side. Low water stage in the Mahoning River is taken as the local datum, or 100. Rock level is 12 to 14 feet above the datum. A bricked ditch along the bin side carries drainage water to a sump just outside. From this well its ordinary outlet is through a 20-inch pipe to the sewer emptying into the river. In time of high water a cut-off valve in this pipe closes it and two 9-inch centrifugal pumps located over the well force the water through a goose-neck by-pass into the same outlet pipe.

Referring again to the plan view, Furnace No. 1 is on the right and is nearest the steel works. From center to center of the furnaces the distance is 300 feet. Each has four stoves, the relation of which and of the bin system will be seen, as referred to below. The plan shows also the pump house, electric power house, blowing engine building, boiler house, etc. The track system, which unfortunately could not be included in so reduced a view, is one of the admirable features of the plant. The left side of the view is toward the upper or northern end of the yards, and here the railroads connecting with the plant have been extending their switching facilities to provide for the expeditious handling of the vast tonnage of raw materials coming to

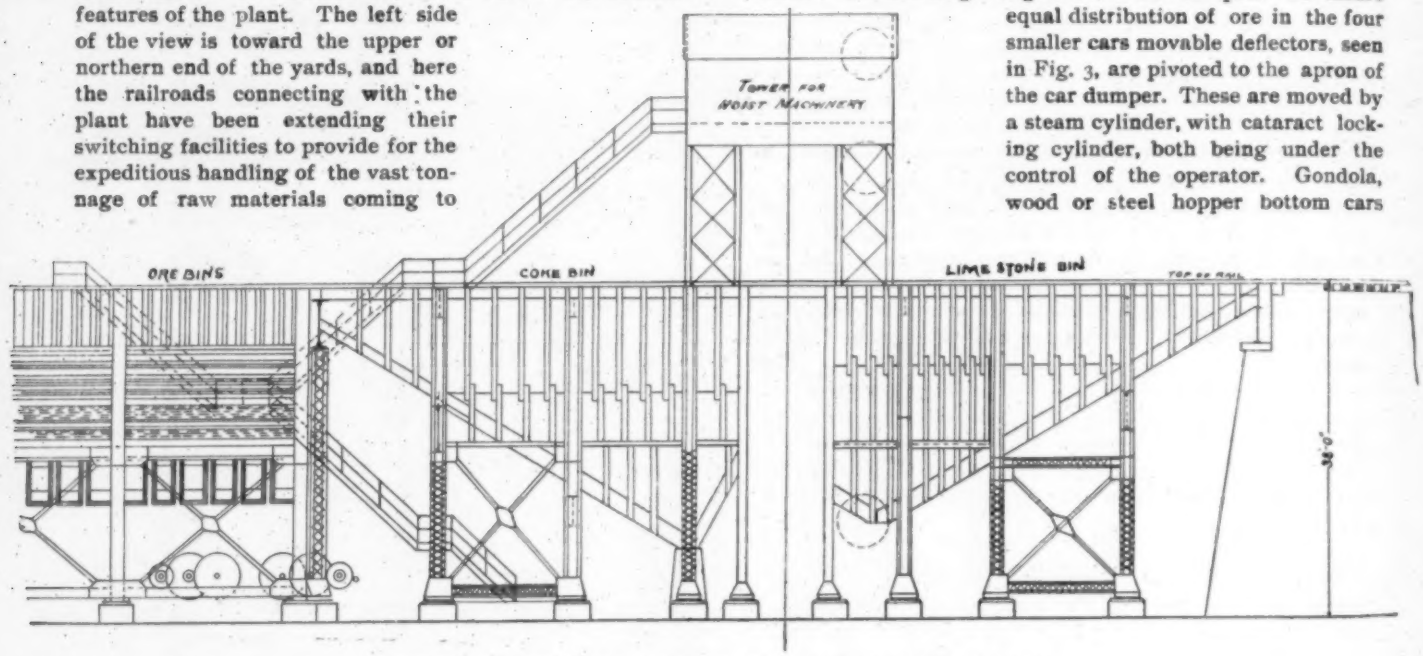


FIG 7.—SECTIONAL ELEVATION OF COKE, LIMESTONE AND ORE BINS.

works so extensive. Coal, limestone and coke come in on the furnace side of the ore stock yard. Ore trains coming from the north enter on tracks on the opposite side of the stock yard, leading to the car dumper, of which more in detail is given below.

Ore Handling Machinery.

The ore stock yard is spanned by two steel conveyor bridges. These with their power equipment, and the other ore handling machinery, consisting of a Hulett patent car dumper, were built by the Webster, Camp & Lane Machine Co., of Akron, O. The bridges have a span of 260 feet, with a cantilever extension of 41 feet over the ore bins at the end next to the furnaces. Each bridge is mounted on a two-track machine tower at its outer or receiving end, and on a one-track rear tower next to the furnaces. At their receiving ends the bottom chords of the bridges are 54½ feet above the bottom of the ore pit and at the rear tower 80½ feet, giving large storage room. The bridges travel along their tracks at a speed of 50 feet per minute by means of gearings connected with two 130 h. p. General Electric motors to each bridge. These motors also furnish the power for handling the ore on the bridge, as well as rehandling it from stock pile, suitable drums and gearing being connected with the motors. The motors take their current from an overhead trolley above the machine tower. As clearly shown in Fig. 2 the machinery is located in the main tower, and an operator's house is placed next to the bridge in a position giving the operator an unobstructed view of the ore cars as they move on the bridge, for this machine delivers ore to the stock piles in small cars instead of buckets.

The location of the Hulett car dumper is indicated in the upper right hand portion of Fig. 5, and is just beyond the limits of the drawing. From the yard in which loaded ore cars are delivered from the various connecting railroads, the track as it extends to the car dumper is down grade 1¼ feet in 100. The foot of the grade is 885 feet from the yard and the cars move this distance by gravity to the foot of a short incline which leads up to the car dumper. In a pit below the loaded car as it reaches the foot of the incline is a disappearing car. This is drawn up out of the pit behind the loaded car by winding drums located on the car dumper. A push bar on the disappearing car engages the drawhead of the ore car, pushing it up grade into the car dumper. The general construction of the car dumper is indicated by the half-tone, Fig. 3. It consists of a substantial steel structure, in which is a platform to receive the loaded car. This platform is pivoted at one side, and when the platform with the carload of ore is rotated around this axis, the car is raised sufficiently high to discharge the ore over an apron into four small steel cars of 17 tons capacity each, mounted on a transfer car standing alongside the car dumper. To insure equal distribution of ore in the four smaller cars movable deflectors, seen in Fig. 3, are pivoted to the apron of the car dumper. These are moved by a steam cylinder, with cataract locking cylinder, both being under the control of the operator. Gondola, wood or steel hopper bottom cars of 20 to 60 tons capacity can be handled.

The car dumper is of the same general design as that furnished by the Webster, Camp & Lane Machine Co., to the Buffalo, Rochester & Pittsburg Railroad for its coal docks at Buffalo, except that the overhead trolleys for conveying the material to vessels are omitted. Steam is piped to the engine for operating the car dumper, from the blast furnace boilers.

After the loaded car is run into the car dumper, the operator sets the deflector for either a short hopper car with ore loaded nearly uniform through the car or for a long gondola with ore loaded at each end over the trucks. The 17-ton cars which receive the ore after it is dumped are of the side-dump pattern. The transfer car on which they stand side by side is pushed by a locomotive under the front or machinery tower of the bridge, in alignment with the four tracks on the latter, which are shown in Fig. 2. These tracks converge to one main track on the bridge, the switches being automatically operated by the car as it passes over them. One by one the cars are drawn up the inclined track and on through the bottom chords of the bridge and dumped at any point desired. This is accomplished by a lever underneath the car engaging a knuckle, causing the two hinged side plates to be thrown outward. A second track is suspended below the chords of the bridge with a trolley running thereon, for rehandling the ore from stock pile, emptying it into cars whence it is dropped into the bins. An automatic bucket of 10 tons

capacity is used in rehandling operations. It is filled by dragging it up the stock pile, which is accomplished by proper manipulation of the trolley by the operator in the machinery tower. In practice there will be no frequent moving of the bridge. When the stock pile from which ore is being drawn is not opposite the bin into which it is desired to put the ore, the 10-ton bucket will empty into motor cars which move to the proper bin and drop their contents. It is possible to bring a train of drop bottom ore cars directly to the tracks over the bins, but the usual method will be by way of the stock yard and the conveyor apparatus.

The capacity of the car dumper is 30 railway cars an hour. Each of the bridges is capable of handling 50 of the 17-ton cars per hour, or an equivalent of 12½ railway cars per hour. Three men are required for the operation of the car dumper, including the man who places cars in position upon it. Two operators are required for each conveyor bridge and three men on the locomotives for moving the transfer cars. The cost of handling ore from railway car to ore-pit or from pit to bins is estimated at less than 1 cent per ton.

The Bin System.

The bin system will be more readily understood by referring to Figs. 5 and 7. The bins are situated inside the stock yard wall in front of and between the two furnaces. The space they occupy is formed by a recess in the wall, 59 feet wide and 320 feet long. Midway between the furnaces are the nine steel ore bins which are common to both stacks. The columns on the stock yard side of the ore bins serve to support the rail of the ore-conveyor bridge which except here is on the stockyard wall proper. Over the ore bins are two standard gauge tracks which are used for the bin-filling cars when ore is being taken from the stockyard; but the tracks are connected with the furnace yard so that the bins may be filled directly from hopper bottom cars independently of the car dumper and stockyard. Between these tracks and the wall is a track for coke and limestone. There is a coke bin and a limestone bin in front of each furnace. As is shown in the drawing, the coke bin is nearest the ore bins and between their inside wall and the wall of the stockyard. On the opposite side of the center line of the furnace is the limestone bin.

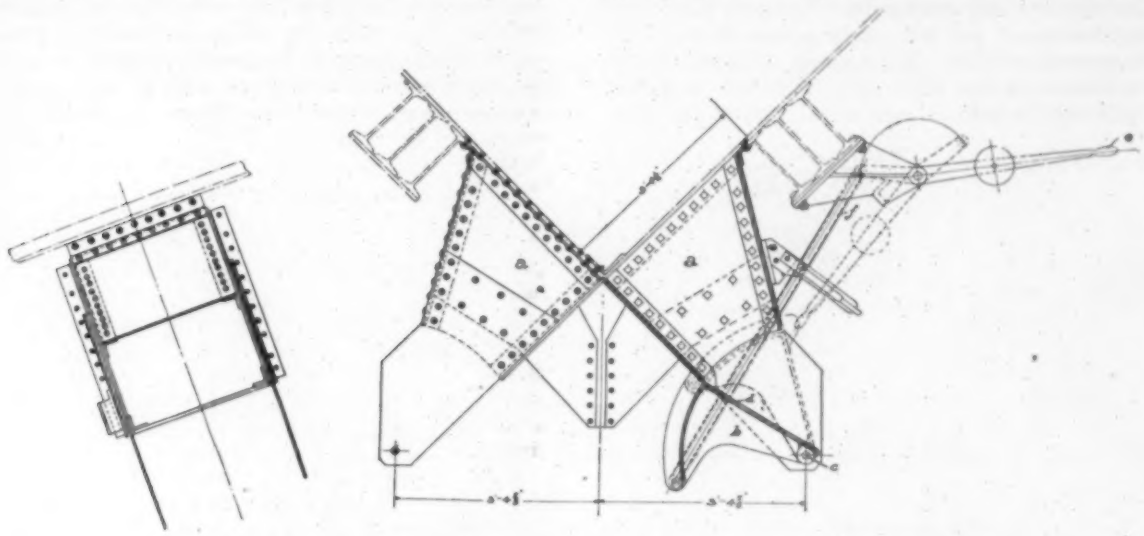


FIG. 8.—BOTTOM OF CHUTE AND END ELEVATION, SHOWING METHOD OF OPENING.

All bins are constructed entirely of steel. The ore bins are 28 feet 6 inches wide and 21 feet long. Their maximum depth, which is on the center line between tracks, is 23 feet. The bottom slopes at an angle of 45 degrees. Their capacity is 500 tons each. To provide against the difficulties arising in handling ore from bins in extremely cold weather pipes are run under the bins, carrying hot water from the steel works.

On the bottom of each bin are 12 chutes, six on a side. The construction of the chutes may serve to illustrate the care with which all details have been designed. Their construction and manner of operation are very plainly shown in Fig. 8. The chute proper consists of an extension of the bottom plate of the bins and side plates *a* to guide the material. The

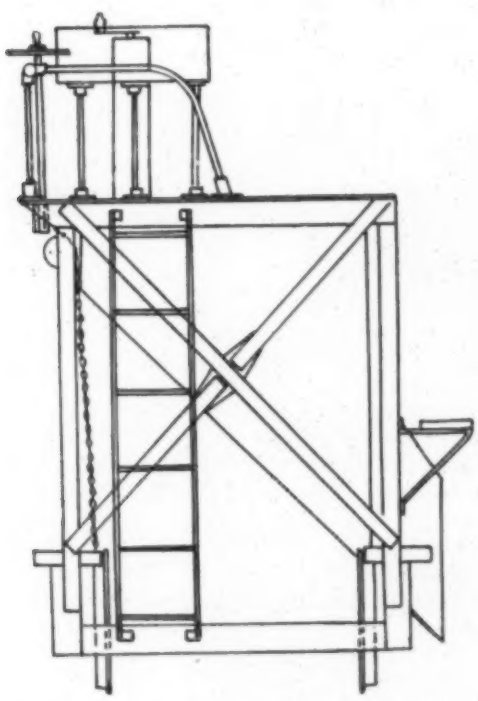


FIG. 9.—END ELEVATION OF ORE SCALE CAR.

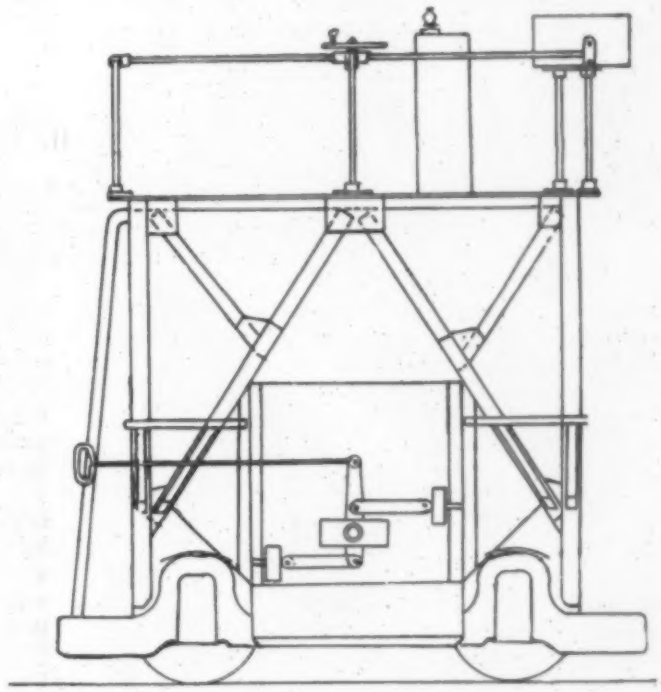


FIG. 10.—SIDE ELEVATION OF SCALE CAR.

gate *b* is a casting pivoted at *c* to an extension of the chute. The face of the gate *b* is an arc with center at *c*, and the side *d* of the casting forms an extension to the chute when the gate is open. The gate is closed by being raised, which is accomplished by the hand lever *e* and connecting link *f*, and is locked in a closed position by throwing the hand lever so as to bring the link *f* past the center. By this arrangement it is possible to regulate perfectly the opening and to avoid leakage due to the closing of the gate. The chutes are arranged opposite each other so that the whole bottom of the bins may be opened, and thus there is very little likelihood of the material arching. The opening of the chutes delivers the ore into scale cars which carry it to the skips. There is one car provided for each furnace, and a track on each side from the other side is the coke bin, of 250 tons capacity. This does not, however, represent the total amount available, as an auxiliary supply is obtained by means of a rope haulage arrangement on the track from which the bins are filled, which enables one man to shift and empty a full train of stone and coke. When a train of coke cars has been placed, the locomotive is released for other service and the rope haulage brings each car in turn over the bin. The chute of the coke bin is operated by a man stationed at the skip pit, whose duty it is also to operate the skip and control the valves for the mechanism on the furnace top. Thus the whole system of handling material from the bins to the furnace top requires a very small expenditure of labor. The significance of this is more apparent when it is remembered that about 1,000 tons of mixed ore

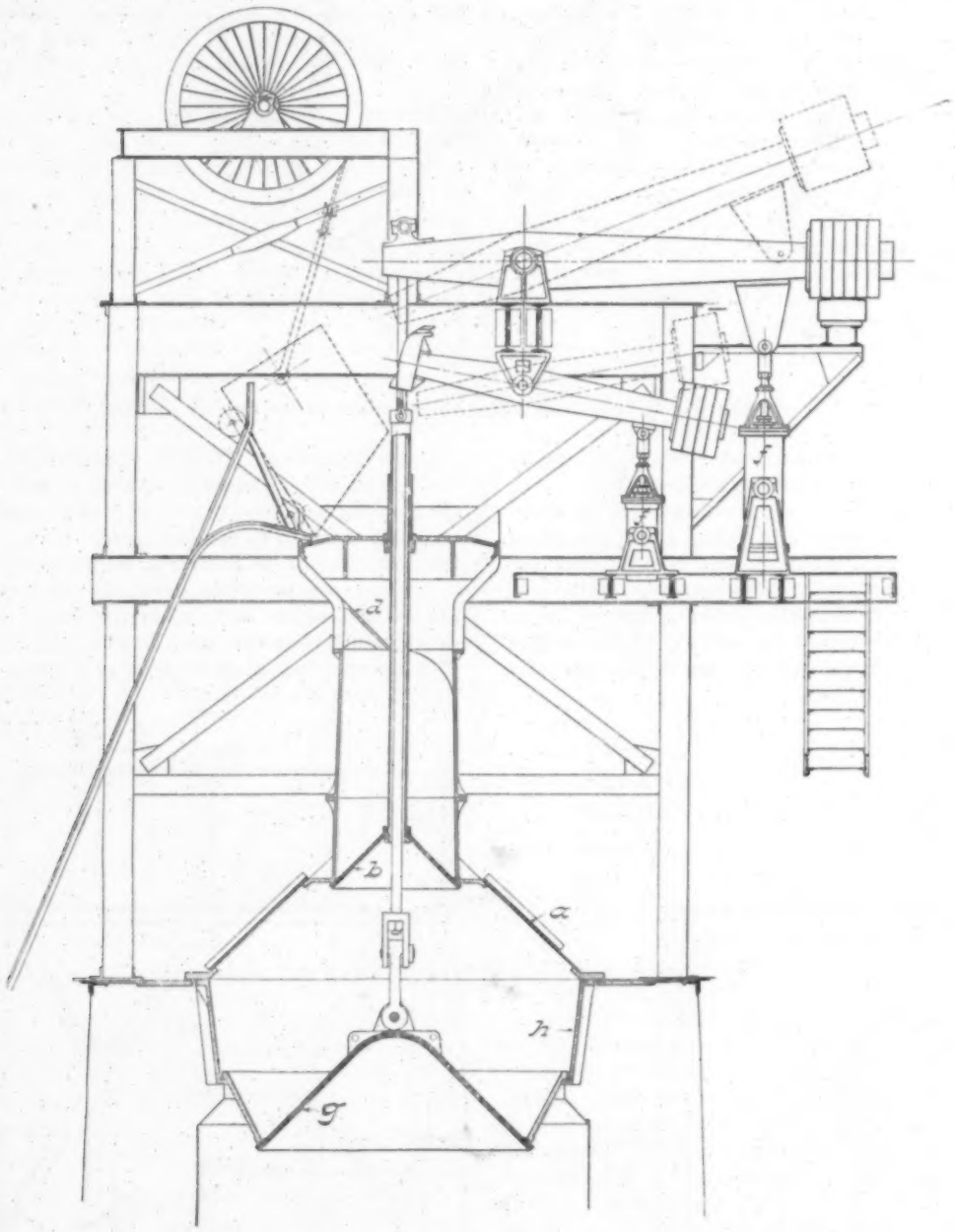


FIG. 11.—VERTICAL SECTION OF FURNACE CHARGING APPARATUS.

of the bins, one leading to each skip so that each car has its own track and there can be no interference. The scale car, as shown by Fig. 10, consists of a hopper, shaped to discharge at the side, supported on scale beams, which are in turn supported on a truck driven by a motor. The current is taken to the motor by a side trolley. On the top of the hopper is the operator's platform. Each car will be provided with a crew of two men, one to run the car and weigh the material, the other to operate the chutes.

The limestone bin of each furnace has a capacity of 570 tons and delivers into a receiving hopper which is supported on scale beams and which in turn discharges directly into the skip. The general arrangement of the operator's platform and scale bin is shown by the accompanying sketch.

Opposite to the limestone bin and discharging into the skip carefully proportioned, 600 tons of coke and about 200 tons of limestone are taken to each furnace top daily.

Furnace Hoist and Top Construction.

From the coke and limestone bins and from the ore scale car the material is taken to the furnace top in a single skip car of 150 cubic feet capacity, or about 7½ tons of ore. The bridge carrying the skip is a firmly trussed structure, whose inclination is 23° 20′ from the vertical. The hoisting mechanism is in a building over the coke and limestone tracks, and is driven by an electric motor of 225 h. p. The Crane Elevator Co. furnished the hoisting equipment. There are two drums both keyed on the same shaft. Two wire ropes, 1¼ inch diameter, lead from the main drum which is 6 feet in diameter, and pass over the 8-foot sheave at the

top, to the skip car. Either is strong enough for the service, one being for safety. The second or counter-balance drum is 5 feet in diameter. Two 1⅛-inch wire ropes lead off it to the counter-balance. The latter is geared 4 to 1, making its travel one-fourth that of the skip car. The counter-balance tower is under the hoisting engine house and forms one of the supports

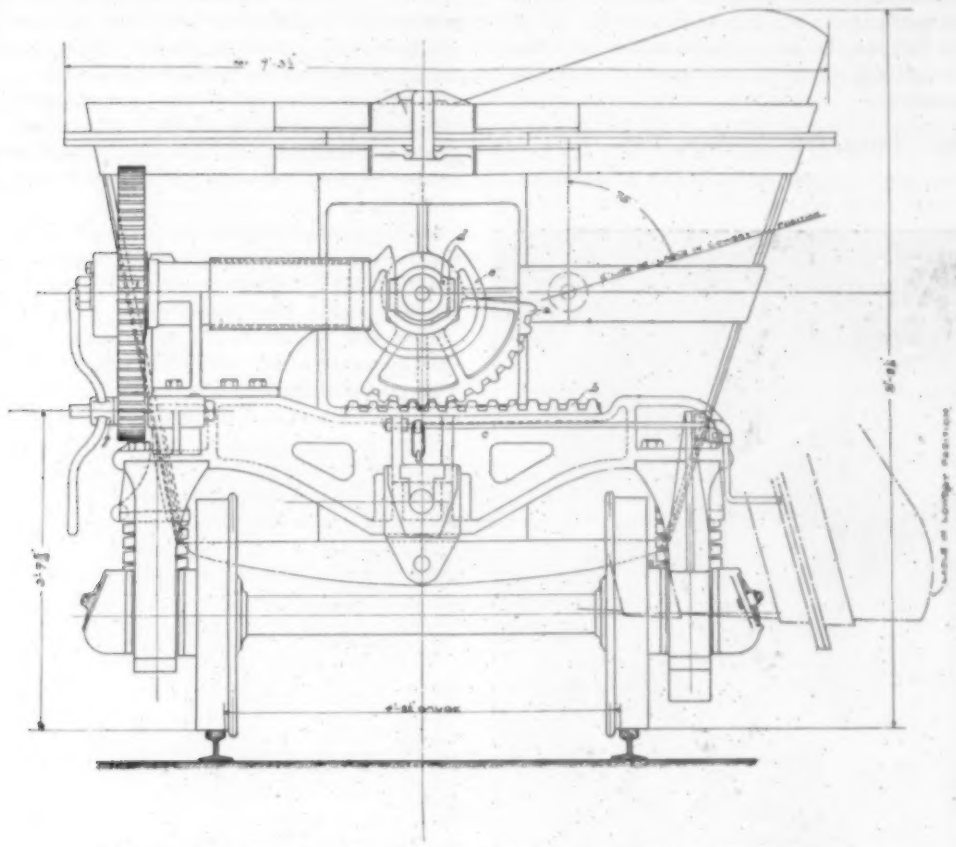


FIG. 12.—END VIEW OF LADLE CAR, SHOWING CONSTRUCTION OF TIPPING DEVICE.

of the latter. The ropes for the counter-balance lead off the bottom of their drum, those for the skip from the top of the main drum, so that the strains are neutralized. The greater part of the descending counter-weight is caught off on springs as the skip reaches the knuckle at the top of the incline where the wide-tread front wheels of the skip run off on a nearly horizontal track. The skip thus approaches the hopper without any shock or any violent change in the motion of the engine.

The hoist motor is guaranteed to take 15,000 pounds of ore from the skip pit to the furnace top in one-half minute, so that the time for a round trip will be about 1¼ minutes.

The furnace top is closed by the ordinary bell and hopper and is provided (Fig. 11.) with a gas sealing hood *a*, and a gas sealing bell *b*. Above the gas sealing bell is a receiving hopper *c*, into which the load of the skip is emptied. This is ingeniously arranged by means of baffle plates *d*, to give a spiral motion to the falling charge, thus correcting the separation of fine and coarse material that the motion of the skip in dumping would otherwise give, and assuring a perfect mixture. The gas sealing hood is of plate work and has six explosion doors in it. The small or gas sealing bell and the receiving hopper have a capacity of one

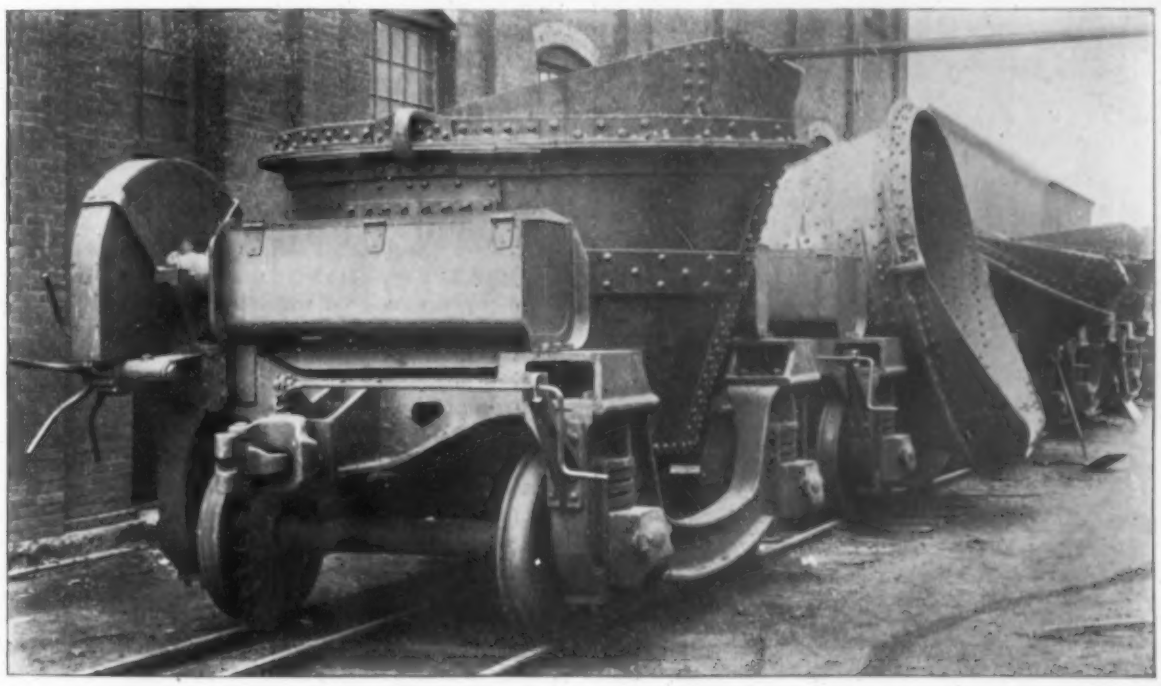


FIG. 13.—LADLE CARS FOR HOT METAL. FRAMES OF STEEL CASTINGS.

skip load. The small bell is guided so that its motion is in a straight line and the distribution of the stock upon the main bell is thus made uniform. Each bell is operated by an oscillating steam cylinder *f*, which is controlled by the operator at the coke chute. The main bell *g* is a steel casting and with the main hopper *h* has a capacity for a charge consisting of 30,000 pounds of ore and corresponding amounts of limestone and coke. Especial provision has been made for rapidly dismantling and putting in new parts, should it be necessary. It is intended that a new bell may be taken from a car on the coke and limestone track and slid up the skip bridge with the aid of the hoisting engine.

Furnaces, Stoves, Gas Washers, Etc.

The furnace proper is the largest yet built and is 106 feet 6

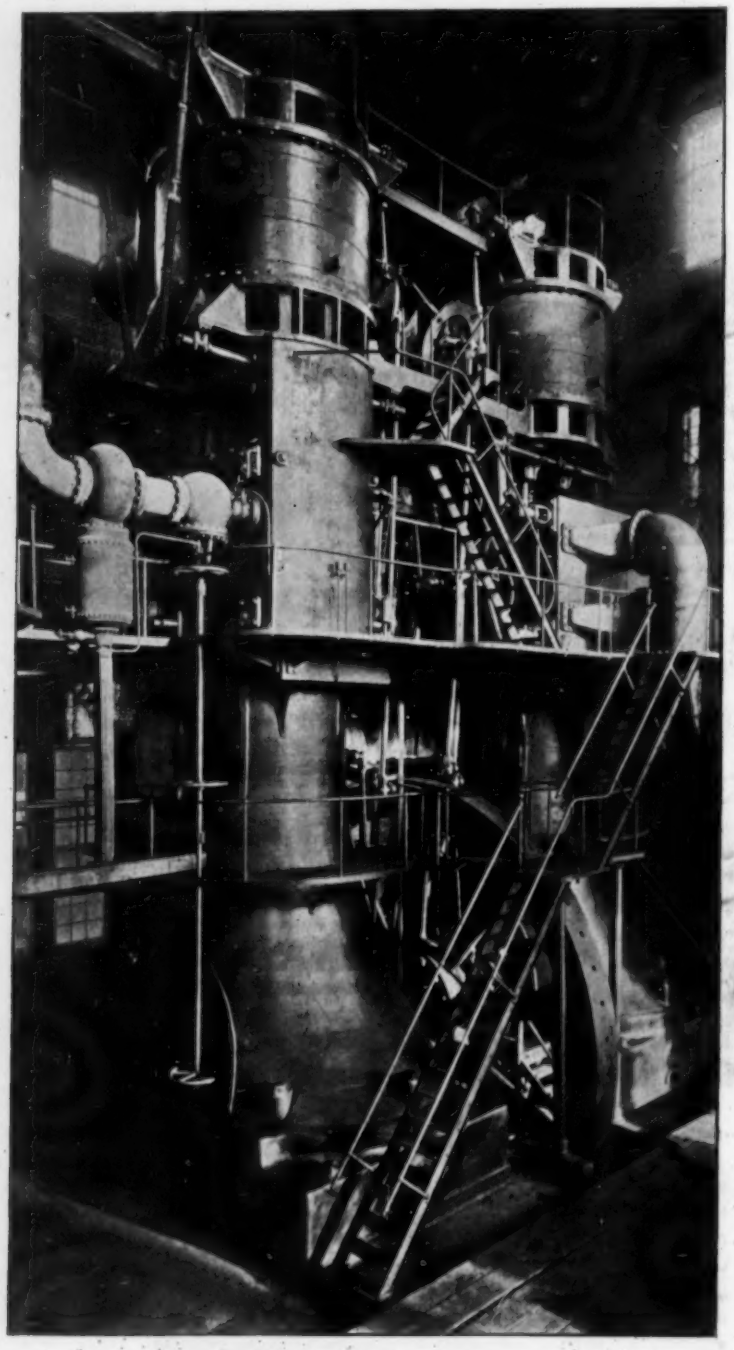


FIG. 14.—ONE OF THE THREE BLOWING ENGINES.

inches from hearth to top floor plate, with a 23 foot bosh and 15-foot hearth. It has eight columns and 16 tuyeres. The walls of the bosh are 31½ inches thick and there are 13 rows of cooling plates in hearth and bosh. About 4,000,000 gallons of water a day for each furnace is used in cooling these plates, the bulk of which is discharged into the waste water trough and is used as condensing water for the condenser. The rest of the water is discharged into the well around the hearth jacket and flows over a weir to the gas washers. There is a sluice gate so placed that this well may be quickly drained in case of necessity. The hearth jacket is of 1¼-inch plate and is 25 feet 2 inches in diameter at the bottom and 22 feet 4 inches at top. Outside the columns is the foundation jacket of 1¼-inch steel, 39 feet 3 inches in diameter.

In the top ring of the furnace shell there are two 42-inch explosion doors, two down-comer branches of 5 feet 9 inches diameter, with two 36-inch explosion doors, and a 36-inch bleeder. The two branches of the down-comer unite into one 7-foot-9-inch main above the dust catcher. There are two gas washers provided for each furnace, one through which the gas for the stoves passes, and one for the gas to the boilers. The washers are of the horizontal type, and are provided with seven baffle plates. At the gas washers in the mains are mushroom valves so arranged as to cut off each washer without preventing the flow of the gas to the boilers or stoves.

Each furnace has four two-pass side-combustion stoves of the Cowper-Roberts style. These are 21 feet in diameter and 118 feet high. The checker work is made of Roberts checker brick. The waste gases from the stoves and the boilers are taken by underground flues to the central chimney stack which is 18 feet in diameter and 225 feet high. The general arrangement of the stoves and furnaces and chimney stack is well adapted to the provision of very convenient galleries and platforms. A through platform extends from one furnace top to the other across the top of the stoves.

Much of the pattern work for the furnaces was done by the Forsyth Pattern Works, of Youngstown, O. The plate work was done by Wm. B. Pollock & Co The steel work for the bins was erected by the Shiffler Bridge Co., of Pittsburg.

Special Ladle Cars.

The cast house is 157 feet long and the metal is carried the whole length in a cast iron runner. This branches into eight troughs which lead to the ladle cars. The construction of these cars is novel and interesting. It is shown in Fig. 12, in end elevation. The ladle when lined with fire clay has a capacity of 25 tons of molten metal and is so shaped as to avoid as far as possible the waste due to metal sculling in pouring. The ladle is built of ¾-inch and ⅝-inch plates and is well reinforced at the top and under the trunnions. Two cast steel trunnions are riveted to the ladle and have keyed to them segments of rollers *a*, whose outer face is provided with teeth engaging a rack *b*. The tracks upon which the rollers travel are supported upon the frame *c* of the car. This frame is built entirely of steel castings and is shown in the half-tone, Fig. 13. It has a wheel base of 7 feet 10 inches on four wheels and has outside boxes of the M. C. B. standard type especially designed for the load. It is also equipped with automatic M. C. B. couplers.

The arrangement of trunnion and rollers above described provides for simultaneously tilting the ladle and rolling it forward upon the truck. The mechanism for tilting is especially noteworthy. One of the ladle trunnions extends beyond the segmental pinion and is enclosed in a brass bushing *d*. This bushing rests in a cast steel yoke *e*, which has cast on it a hollow sleeve threaded upon the inside. This thread engages a screw which is keyed to the gear wheel *f*, driven by the pinion and hand-wheel *g*. This design gives protection for the working parts, and will be recognized as a marked advantage to mechanism in this service. As the crosshead moves foward it carries with it a part of a telescopic shield. Besides this shield, the whole crosshead, rack and gear wheel are covered as is shown in Fig. 13, and perfectly protected from any splashes of molten metal or other injury. Another advantage of this tipping mechanism is that it is possible to take the ladle from the truck for relining without in any way dismantling the mechanism. The ladle and ladle trunnions are lifted out of the yoke of the crosshead and a new ladle set in place with very little delay, thus permitting a smaller number of cars to do the work than would otherwise be possible. In the ladle house where the ladles are relined is a traveling crane for lifting them out and placing new ones in position. Provision is also made for drying the newly lined ladles, furnace gas being burned for this purpose. The ladle tipping arrangement was designed by Chief Engineer M. A. Neeland and is covered by patent.

There is another interesting adjunct to these cars in the

hot metal reservoir building. A man may easily tilt these ladles by hand yet it is accomplished more quickly by this mechanical device. At the mouth of the reservoir is a motor with a stand and universal joint which is connected to a square shank at the hand-wheel and enables the operator to tilt the ladles as rapidly as desired.

All of the metal from the furnace is taken in these cars—the Sunday output to the pig casting machine; the week-day casts to the hot metal reservoirs. The cinder is taken in cinder cars of 200 cubic feet capacity and will be used for filling low ground. The pig iron casting machines are furnished by Heyl & Patterson, of Pittsburg, and will be located on the opposite side of the ore stock yards from the furnaces, not far from the car dumper. The hot metal will be conveyed to them on tracks making the circuit of the north portion of the yards, the distance from No. 1 furnace being about one-half mile. The casting plant complete will consist of four strings of molds, driven by a 60 h. p. electric motor. The Heyl & Patterson machine was described in our issue of May 18.

Blowing Engines.

For the two furnaces there are three blowing engines installed by Wm. Tod & Co., of Youngstown, O. They are of the vertical, cross compound, condensing, quarter crank, steeple type, with steam cylinders 54 and 102 inches in diameter, 60 inch stroke, and two air cylinders 108 inches in diameter, 60 inch stroke. The total weight of each engine is 635 tons. With a steam pressure of 160 pounds gauge, and 26 inches vacuum, the engines will develop 5,000 I. H. P. each, at 45 revolutions per minute, and will blow 57,240 cubic feet of free air per minute to a pressure of 25 pounds per square inch.

The bed plates weigh 56 tons each, and two are required for each engine. They are made in box section, cored, and so designed as to give a total area of bottom plate, excepting a few small holes for removing cores, for bearing surface on the foundation. The housings are bell-shaped, made of two pieces, and enclose the cranks and connecting rod. The guides are circular, in one piece, and were bored out in a vertical position to 70 inches diameter, with 31 inches circular bearing faces. The length of the guide bearing surface is 103 inches.

The crank shaft is 18 feet long, and 28 inches in diameter, made of forged steel, solid, and reduced to 26 inches diameter at the bearings. The crank discs are cast steel, circular and counterweighted. The weight of the shaft, the two crank discs and the fly-wheel hub is 56 tons. The main bearings are 26 inches x 44 inches, and are provided with removable cast steel shells on the top and bottom.

The fly-wheel is made up in 10 segments, bolted at the hub, and tied together with three shrink links at each joint in the rim. The rim section is 19x19 inches, and the wheel diameter is 24 feet; the weight 70 tons. The connecting rods are of forged steel, and 12 feet 6 inches between the center of the crank pin and the wrist pin, and are fitted with marine ends. The crank pins are 18 inches x 15 inches. The wrist pins are 16 x 16 inches. The bearing surfaces at the wrist and crank pins are babbited. The cross-heads are cast steel and connected to the steam pistons with two piston rods, each 8 inches in diameter, and of forged steel. The shape of the cross-head permits the adoption of large bearing surfaces between the cross-heads and guides. The length of the cross-head shoe is 43 inches, and the two circular faces are 31 inches wide each.

The high and low pressure cylinders are 54 inches and 102 inches in diameter, respectively, and the volumetric ratio is 1 to 3.56. The stroke is 60 inches and the piston speed at 45 revolutions is 450 feet per minute. Both cylinders are equipped with Corliss valves, the high pressure valves being 9 inches diameter by 65 inches long, and the low pressure valves are 15 inches in diameter by 117¼ inches long. The weights of the completed cylinders, including heads and valves, are 20 tons for the high pressure and 45½ tons for the low pressure. The governor is of pendulum type and acts on the high pressure cylinder, the low pressure cut-off being regulated by hand. Provision is made that in case one side of the engine should be disconnected, the governor will control the side in operation. The design of the governor is such that the speed of the engine can be changed at the governor from 20 revolutions per minute to 50 revolutions per minute, the governor controlling the engine at whatever speed set.

The air pistons are connected to the steam pistons by one forged steel piston rod 9 inches in diameter, on each side of the engine. The air valves are operated through a wrist plate, and so arranged that the movement is positive, yet would be controlled by the air should any accident befall the

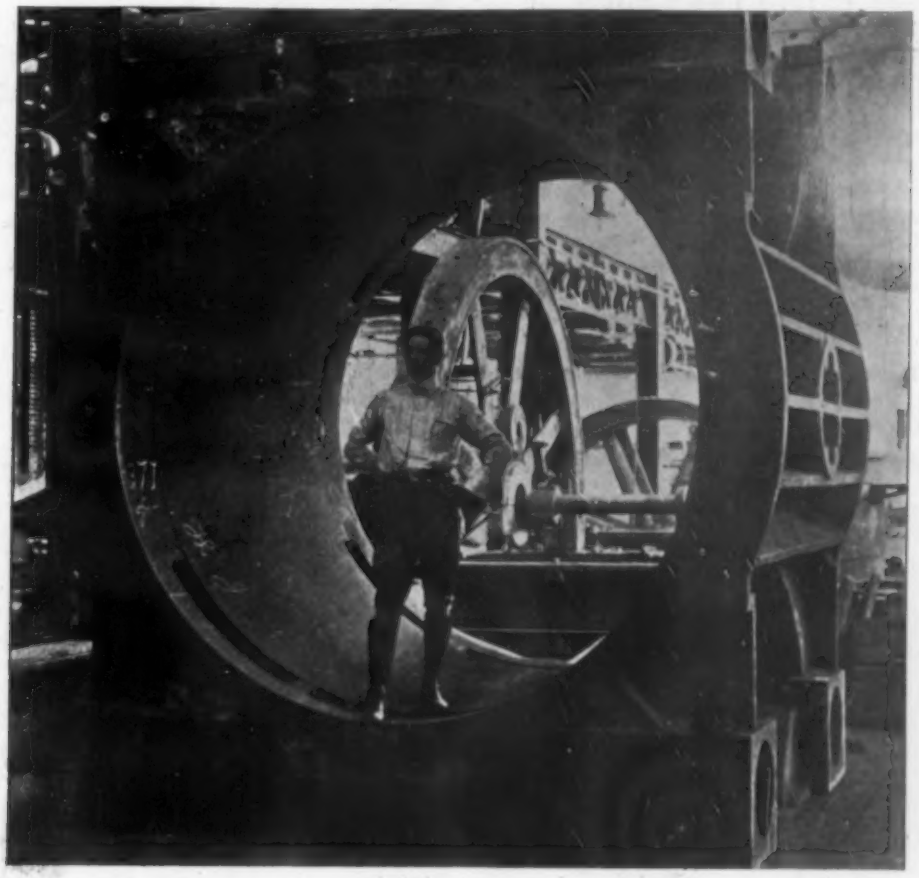


FIG. 15.—LOW PRESSURE CYLINDER OF BLOWING ENGINE. DIAMETER, 102 INCHES. WEIGHT 29 TONS.

operating gear. The inlet valves are cast steel and open inwardly. The outlet valves are pressed steel, opened by the air pressure, and are closed positively, and all air openings are designed to have sufficient area for a piston speed of 500 feet per minute.

The Boiler Plant.

For the two furnaces there are two boiler houses each 178 feet by 40 feet, with a space of 20 feet between them. In this space there are two underground chimney flues leading to the central stack. To this flue each boiler is connected by a breeching pipe coming out of the building and turning down to the flue.

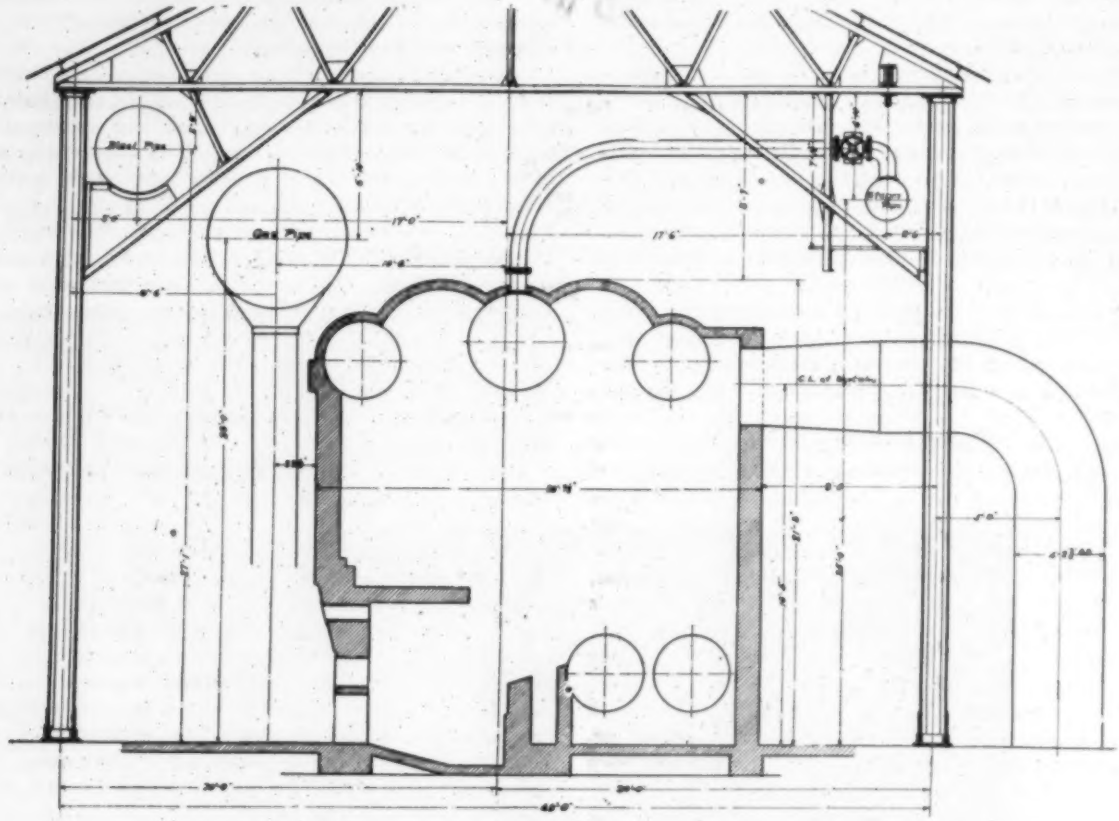


FIG. 16.—SECTION OF BOILER HOUSE FROM FRONT TO REAR, THROUGH SMOKE FLUE.

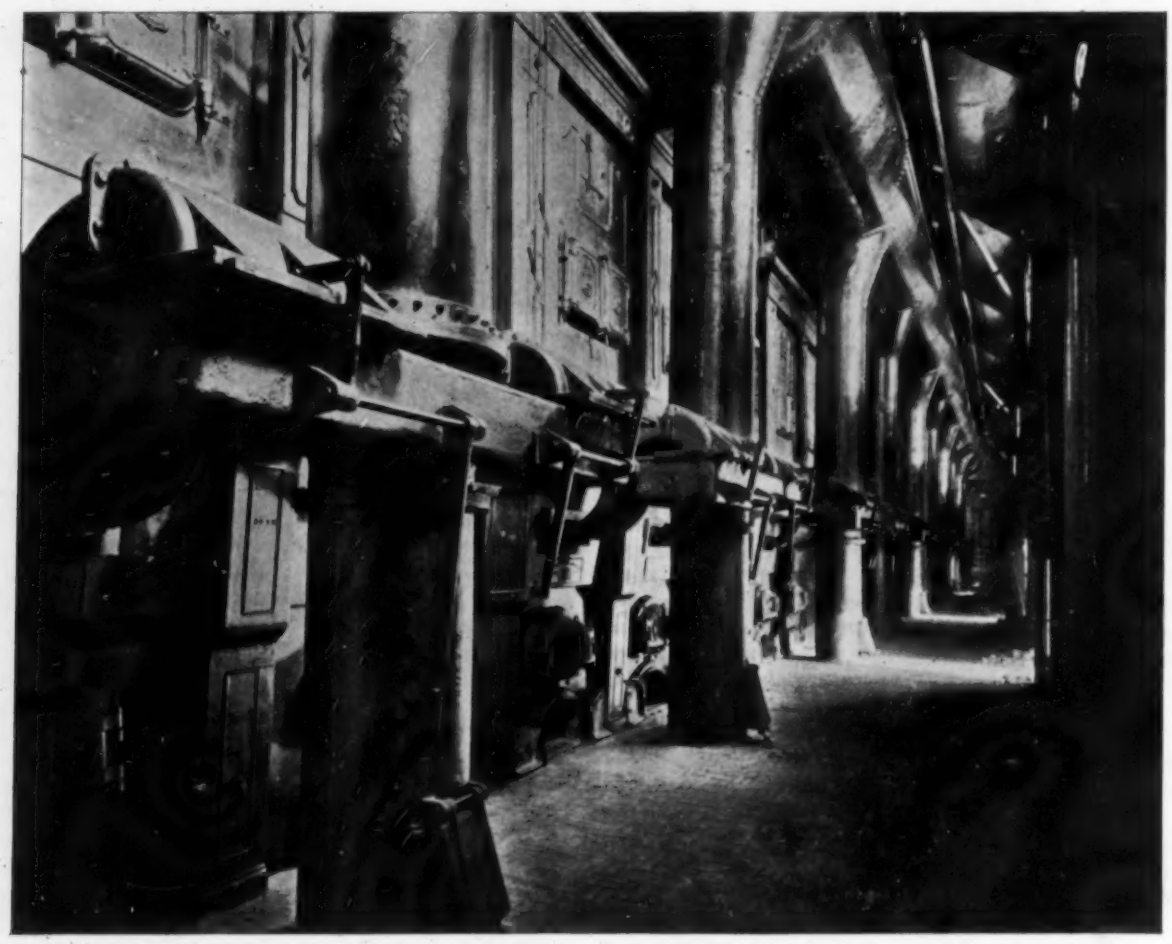
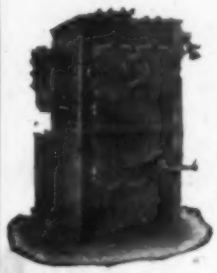


FIG. 17.—VIEW IN ONE OF THE BOILER HOUSES, SHOWING 3,500 H. P. OF STIRLING BOILERS.

The blowing engine house is commanded by a 30-ton electric traveling crane.



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HARRISON SAFETY BOILER WORKS,

Clearfield & Seventeenth Sts., PHILADELPHIA, PA.

The boilers are of the Stirling water tube type, with a total for the two furnaces of 7,000 h. p., made up of 16 boilers of 360 h. p. each and four of 333⅓ h. p. each. The boilers are set in batteries of two boilers each making four batteries of 720 h. p. each and one of 666 h. p. in each boiler house. The drums are 16 feet 6 inches long and 42 inches in diameter, with the exception of the central drum, from which steam is taken, this being 54 inches in diameter. The tubes are all 4-inch, and so spaced as to allow of any tube being removed without the necessity of destroying a good one. The boiler pressure is 160 pounds. The settings are provided with Stirling patent explosion doors, and also with a special arrangement for blowing off accumulations of furnace dust from the exterior of the boilers when in operation.

The principal fuel for these boilers will be furnace gas, though grates are provided for the use of coal in case of emergency. Along the front of the batteries and overhead is a gas main 6 feet 6 inches in diameter, which carries the gas from the washer to the boilers. In front of each boiler is a down-take to the gas burner. There are two burners to each boiler, opposite openings in the boiler front 7½ inches by 27 inches. The burner proper rests upon a valve seat and is operated by means of a hand lever. The space in front of the boiler occupied by the burner and stand is 3 feet.

The location of the boiler house and the engine house is such as to require but short steam lines to the engines. A 16-inch line is run from the furnace boiler house to the steel works to take care of any surplus steam. The pumps are supplied by two 8-inch steam mains which are altogether independent and so provide against any accidents. For the No. 3 furnace, recently started, the boiler plant will consist of 10 Stirling boilers of 400 h. p. each, so that the total installation at the three furnaces will be 11,000 h. p.

The Pumping Plant.

The requirements of the two new blast furnaces, the third one under construction and the steel works will be about 24,000,000 gallons of water in 24 hours. For cooling water for the blast furnaces, for condenser supply, and other purposes, requiring a head of 130 feet, provision is made for pumping from the Mahoning river 18,000,000 gallons of water daily. This plant consists of three horizontal duplex triple expansion Snow pumping engines, each with a capacity of 6,000,000 gallons in 24 hours. Only two will be in use, one being in reserve. These pump either into the stand-pipe or direct into the circulating system. The stand-pipe is located just outside the pump house and is 20 feet in diameter and 131 feet high. The inlet pipe rises to a point, two feet from the top and the water falls over a screen. The mouth of the 36-inch outlet pipe is 17 feet from the bottom of the stand-pipe, giving ample settling space. The water flows from the river to the pump house through a circular tunnel five feet in diameter driven through the rock, extending under the stock yard as shown in the plan. There is a well at the pump house into which the conduit discharges; this is 60 feet by 8 feet and 10 feet deep at low water. The intake of the tunnel is built of stone masonry in which a sluice gate is mounted. By closing the gate it is possible to drain the conduit and well in the pump house.

In addition to the three 6,000,000-gallon pumps are two 10,000,000 gallon centrifugal pumps installed by the F. R. Dravo & Co. These serve the Worthington condensers. One is operated and one is a spare. A central condenser is installed for all engines at the furnace plant. There are three exhaust mains entering the condenser, a 56-inch from the blowing engines, a 36-inch from the electrical engines and an 18-inch from the pumps. The auxiliaries of the condenser consist of a dry vacuum pump and a centrifugal pump each connected to an independent steam engine. Three-fourths of the bosh water, as stated above, is used as condensing water without being pumped. The remainder of the condensing water required is furnished by the pump just mentioned which draws from a cold well, fed by the centrifugal pumps in the pump house.

Electric Power Equipment.

The electric power house, the location of which is shown on the general plan in Fig. 5, supplies electrical power for blast furnaces and steel works. It is a steel and brick structure 187 feet x 55 feet, near the blast furnace engine house. This location was chosen rather than a more central one because the cost of transmission was more than offset by the availability of furnace gas as fuel. The entire electrical equipment of the power house was furnished by the Westinghouse Electric & Mfg Co., and consists of two550 k. w. engine type generators, direct connected to horizontal cross compound McIntosh, Seymour & Co. engines, two 200 k. w. generators belted to tandem compound Buckeye engines and one 200 k. w generator belted to a Ball engine. All the engines will be connected with the central condensing plant when the latter is completed. The switch board is of black enameled slate, consisting of five generator panels, one load panel and 11 feeder panels, all containing the most modern instruments. Two hundred direct-current constant potential enclosed arc lamps of General Electric and Helios make are used in the various departments. The 250 v. current from the main switch board is supplied to an arc board from which it is distributed over ten circuits. All the outside lamps burn singly on 250 v. while for inside use, lamps burning two in series are preferred, because of the whiter quality of the light. Besides the arc lamps four 18-inch search lights will be used at the furnaces to assist in the operation of the ore bridges.

About 1,000 incandescent lamps are required, and are supplied with current by a rather novel piece of apparatus. A two-phase 75 k. w. Westinghouse rotary transformer takes the 250 v. direct current from the power generators and transforms it into alternating current at 170-v. pressure. This current is then raised to 2,000 volts by static, oil-insulated self-cooling transformers and distributed over the works. Two of these units have been installed, so that one can be held in reserve. A five-panelled back enameled marble switch board has mounted on it all the apparatus that is necessary for controlling and distributing this current. At one end of the power house is the repair shop, testing room and office. What repairs are necessary in the electrical department are made here, practically nothing being sent away from the works. Current for power and lights is distributed on pole

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At present there are in use about 80 electric motors aggregating 1,800 h. p., employed on the traveling cranes, in various shops, on cable pulls, mill transfer tables, etc. In the new rail finishing mill and blast furnaces now approaching completion there will be about 60 more motors which will increase the total h. p. to 4,000. These motors are about evenly divided between General Electric, Crocker-Wheeler and Westinghouse makes. The reliability and efficiency of electric apparatus for mill use have been fully demonstrated at the Ohio Works in many ways. Less than 8 per cent of the delays in the mill are attributed to it. Heretofore the entire water supply of the mill has been furnished by electrically driven pumps, which have been in constant operation for two years without a single case of trouble developing. These will not be required, however, after the furnace pump house is in operation. It would appear that electricity as a factor in mill operation is becoming increasingly important.

Labor-Saving Efficiency.

As will be inferred from the detail given above the new furnace plant promises special economies in the handling of material and in efficient operation. It would seem that the minimum had been reached in the number of men required for the laborious and diversified service called for in connection with blast furnace work. The practice at these furnaces, which have been so admirably planned and equipped under the direction of the engineers of the National Steel Co., will be watched with great interest. It is expected that No. 1 furnace will be started in January.

The engineering features of the plant have been developed under the supervision of Thomas McDonald, general superintendent of the National Steel Co.; John Reis, general manager of furnaces; M. A. Neeland, chief engineer; Guy R. Johnson, superintendent of the Youngstown furnaces of the company. Julian Kennedy was consulting engineer.

THE CHICAGO DISTRICT.

The plant of the Palmer Steel & Iron Co., at Muncie, Ind., will be enlarged and improved considerably during the coming year, and the output will be increased nearly 100 per cent. The interests of John W. Briggs in the company have been purchased by J. H. Palmer and W. J. Moody, and S. M. Bradshaw, of Muncie, has been elected on the board of directors in the place of Mr. Briggs. The offices of the company are at 234 La Salle st., Chicago.

A new concern in Chicago is the Thomas Belting Co., whose incorporation with a capital stock of $25,000 we noted last week. The company is officered by J. M. Thomas, president, and G. O. Thomas, secretary and treasurer. It has secured the four-story building at 46 and 48 South Canal st., and will manufacture leather belting of all kinds, and deal in all kinds of mill supplies. The offices of the company have been opened for business, and the plant will be running soon after the first of the year. For a number of years the president of the company, J. M. Thomas, was connected with the Chicago Belting Co.

Samuel Harris & Co., 23 and 25 South Clinton st., Chicago, have been made sole agents for the United Flexible Tubing Co., Ltd., of England, manufacturers of bronze and steel flexible tubing, for steam, compressed air, water, gas, oils, etc. It is claimed this tubing is a perfect substitute for rubber hose for the purposes for which it is used, and is unaffected by climatic variations and practically indestructible. Special attention is called to the claims made that the metallic flexible tubes with a smaller diameter, interior measurement, will give the same service as rubber, linen or leather tubes with a larger diameter, as they do not kink and always keep the same opening in whatever curve they assume. Samuel Harris & Co. announce that they have just received a large consignment of this tubing, and are prepared to fill all orders.

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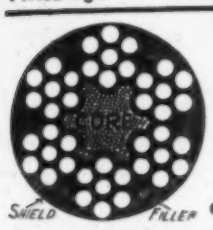

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Greater Activity in Tin Production.

The high prices of tin which have prevailed during the latter half of the present year are producing their natural effect, and we hear of the prospective or actual opening of new tin mines in various parts of the world. In the Malay Peninsula, the number of Chinese miners and prospectors is increasing, and new ground is gradually being opened. Although the slow methods of the region make some length of time necessary, for the usual preliminary work, there is no doubt that the production of Straits tin will before long show a considerable increase. In the Dutch East Indies, especially in the Billiton and Singkep mines extensions are also being made, and next year's production will probably be larger than ever before. In Australia and Tasmania, prospecting for tin has been very active, and although new properties are not being added very rapidly to the producing list, there is still some prospect of a future increase. The most notable new mine is the Briseis in Tasmania, to which our London correspondent refers on another page, and which appears to have considerable promise, although it still is in the preliminary stage. Upon the whole, we may expect an increase in the world's supply of tin during the course of the next year, which may attain considerable proportions. Meantime the speculation in the metal appears to have passed its height, and there has been a marked reaction in prices, although they are still far above the level of last year.—(Engineering and Mining Journal.

THE National Association of Brass Manufacturers in session at Detroit elected the following officers: President, A. F. Blesch, Columbus, O.; first vice-president, George T. Coppins, Boston; second vice-president, H. M. Hoelscher, Chicago; treasurer, J. B. Kalveladge, Milwaukee; secretary, William T. Doyle, Milwaukee.

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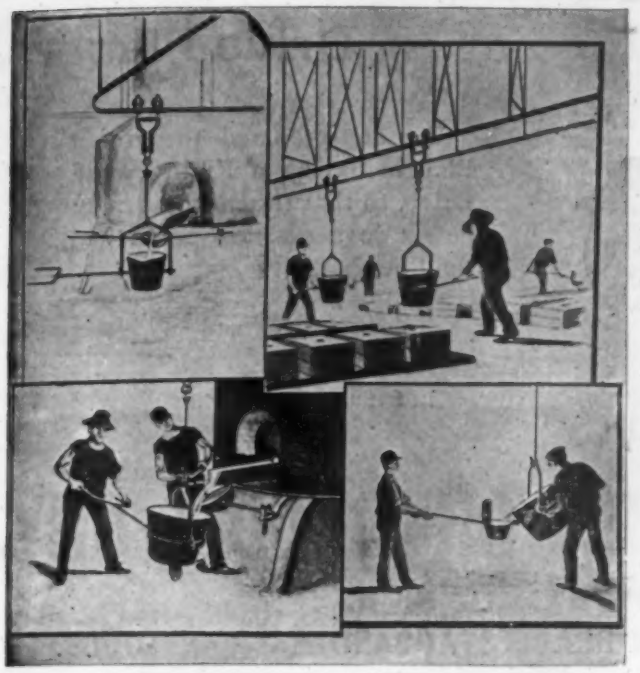

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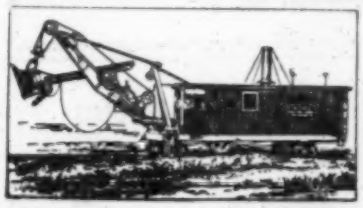

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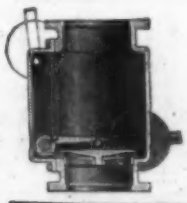

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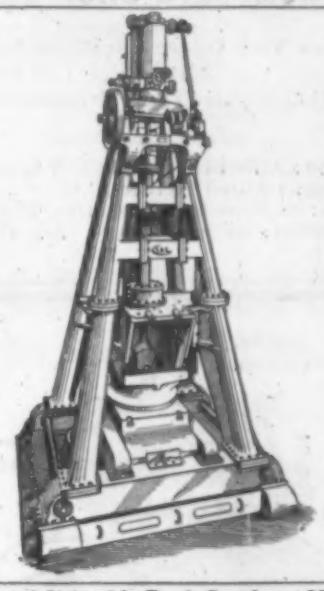

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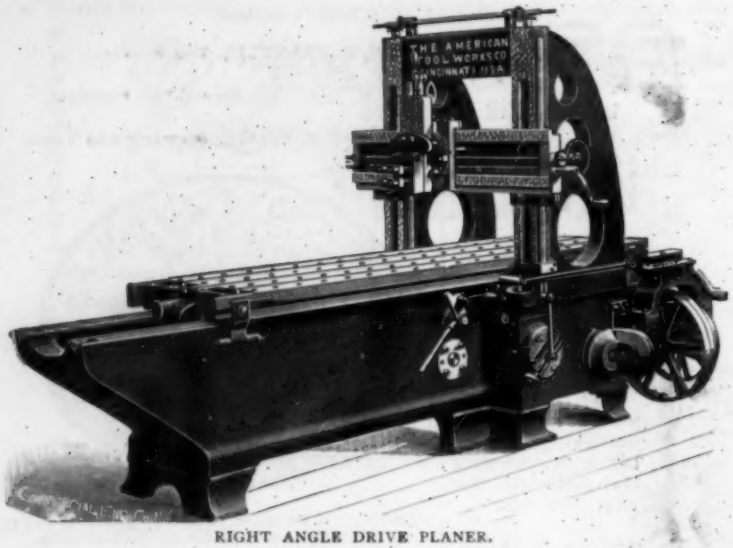

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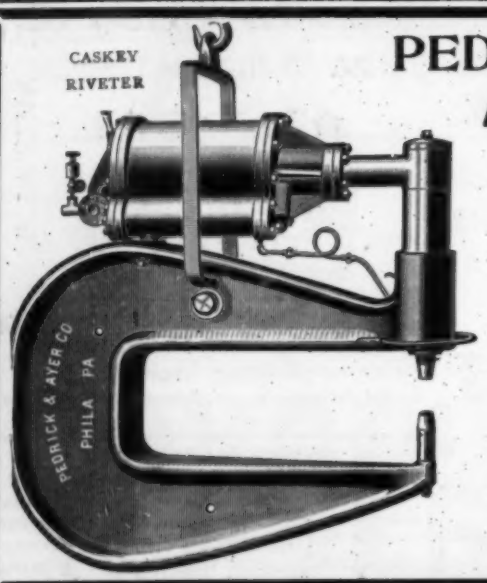

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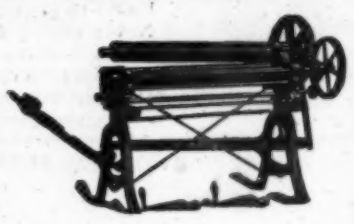

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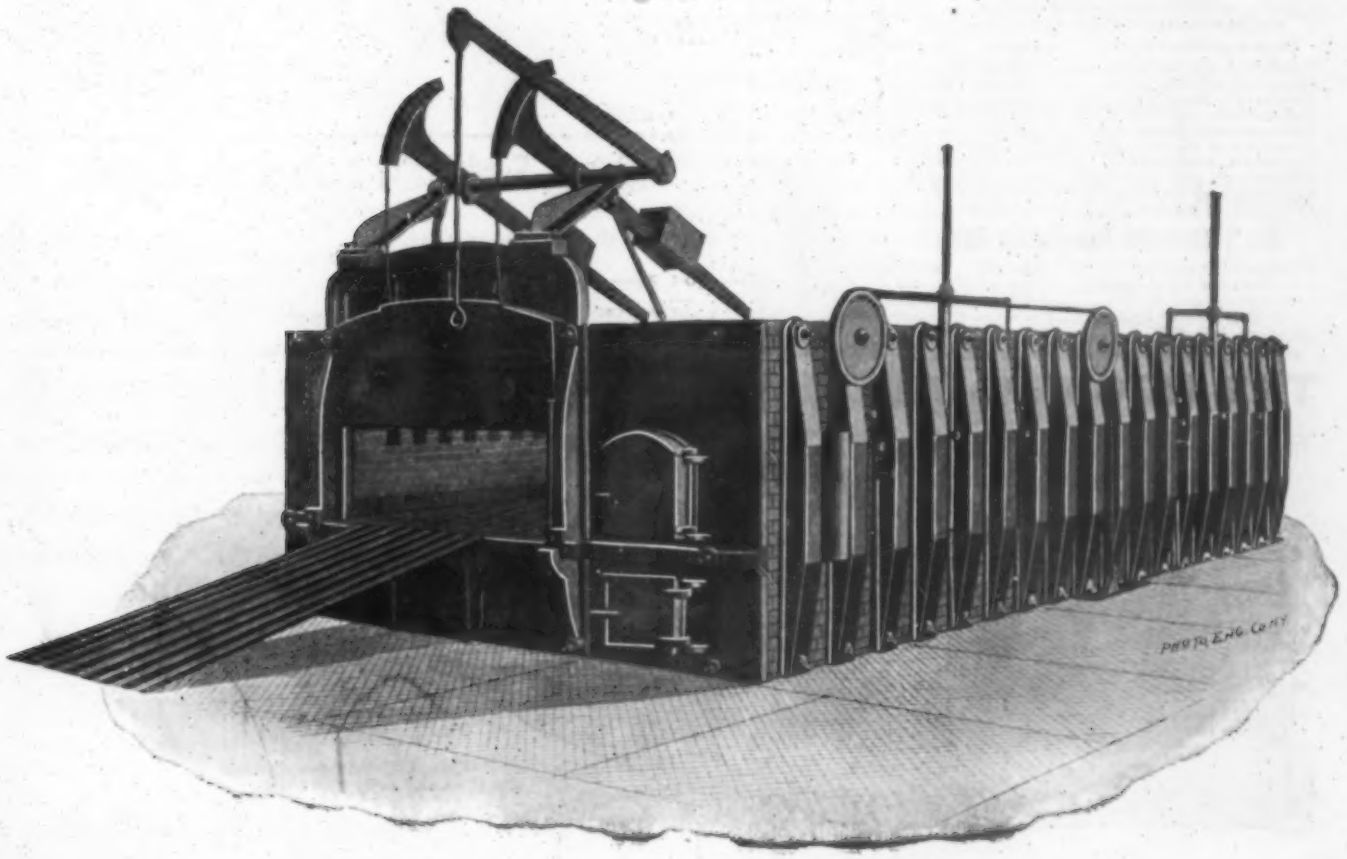

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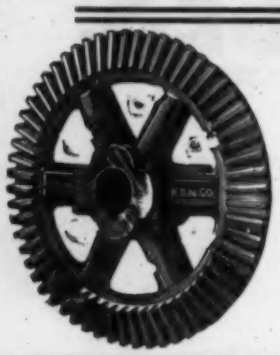

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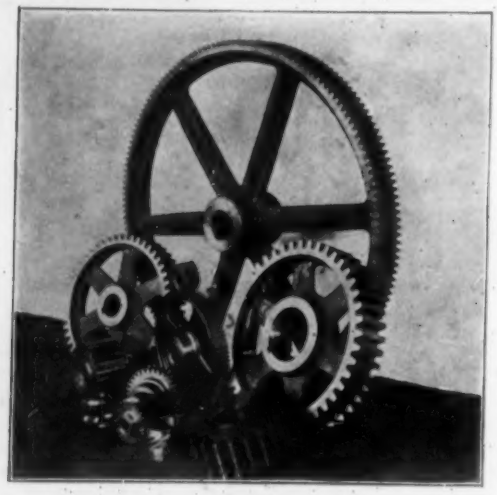

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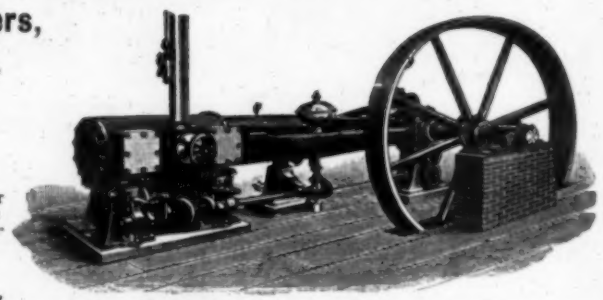

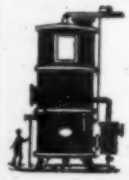

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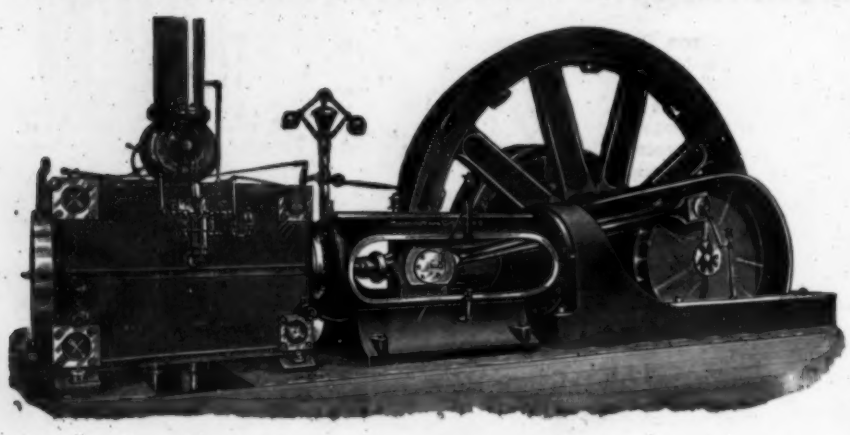

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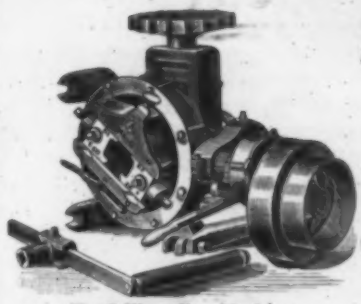

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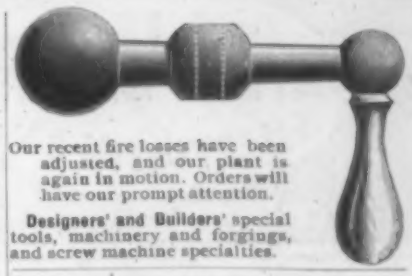

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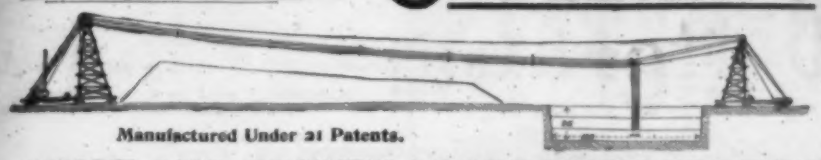

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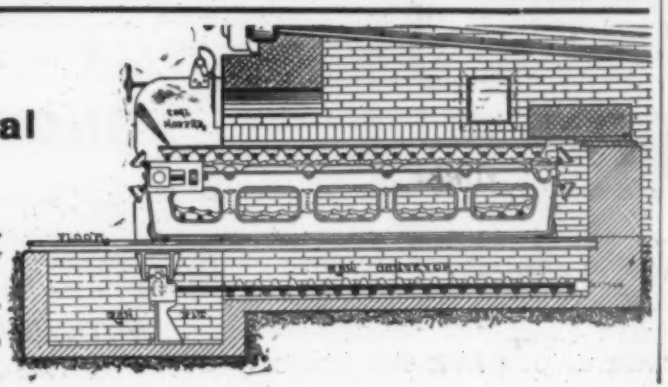

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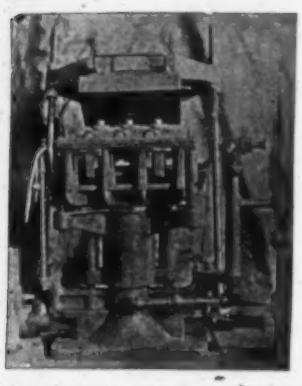

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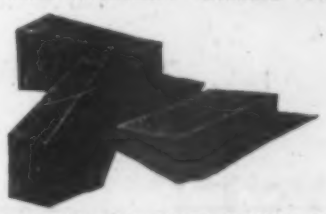

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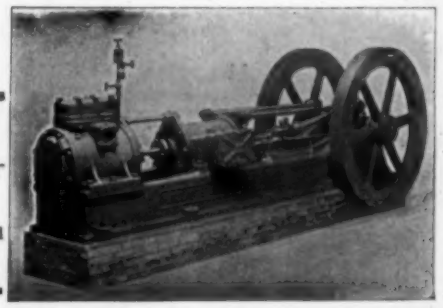

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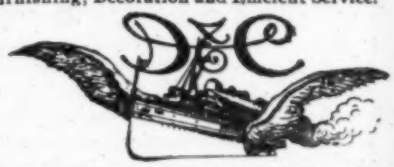

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Wire Nail Works,
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Chain Works,
Bolt, Nut and Rivet Works,
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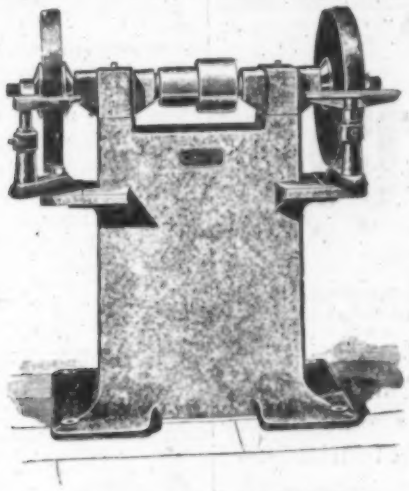

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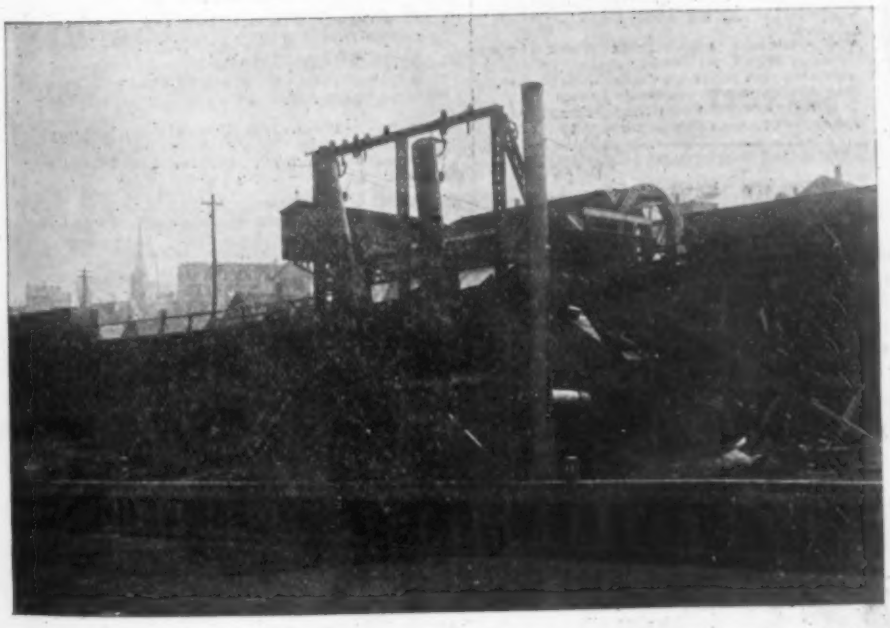

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CREMER & BICKNELL'S

Chemical and Metallurgical

HANDBOOK

EXTRACT FROM PREFACE:

In the preparation of the second edition of our Handbook, the general plan of the first edition has been followed, viz., to present in concise form such data and information as are useful to the chemist and metallurgist. Several tables of the first edition, which were of somewhat limited use, have been omitted, while more than one hundred pages of new matter have been added.

The methods for analysis of iron ore, iron and steel and for assaying have been given briefly, but perhaps as much in detail as is consistent with the general scope of the book. Several changes and additions to the Specific Gravity tables have been made by adoption of later and more accurate values.

In the notes on blast furnace practice have been outlined the more important theoretical and practical points, which, it is hoped, will be of some service to those interested in the manufacture of iron.

The hygrometric table gives the necessary information for determining the amount of moisture in air, a subject whose importance in metallurgical operations is being more fully recognized at present than heretofore. This table is new and is based on the most accurate data available at the present time.

The tables of weights and measures, United States and foreign, have been very much amplified, and the conversion tables for United States and metric weight and measures of the U. S. Coast and Geodetic Survey included, the latter being based on the legal standard for this country.

Numerous miscellaneous tables have been added, which, it is hoped, will be found of value

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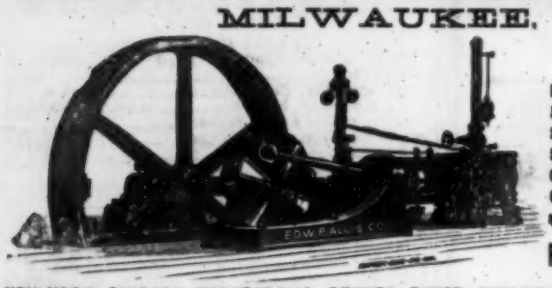

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William Tod & Co.
YOUNGSTOWN, OHIO.

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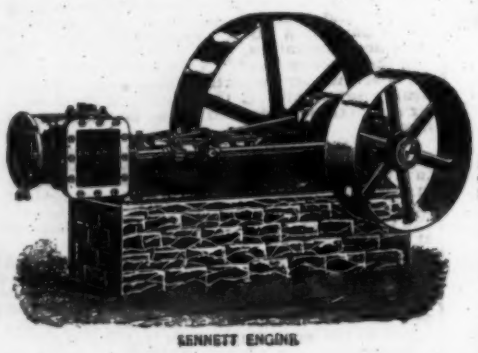
PARK BUILDING, PITTSBURG, - - Seward S. Babbitt.



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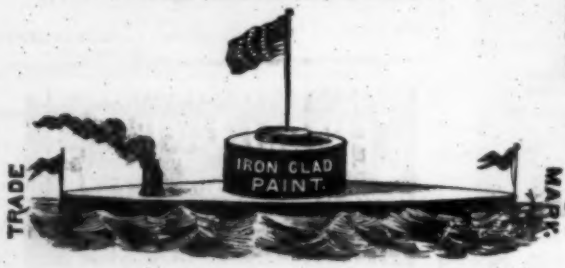

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Hall Steam Pump Co., Pittsburg, Pa.
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Manning, Maxwell & Moore, New York City.

AIR LIFT PUMPS—
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Merchant & Co., Inc., Philadelphia, Pa.
F. R. Phillips Sons' Co., Philadelphia, Pa.
J. J. Ryan & Co., Chicago, Ill.

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Perfect Lubricating Metal Co., Cincinnati, O.
Magnolia Metal Co., New York City.
Merchant & Co., Inc., Philadelphia, Pa.
James B. Clow & Sons, Chicago, Ill.
Lorain Foundry Co., Lorain, O.
J. J. Ryan & Co., Chicago, Ill.

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Bourne-Fuller Co., Cleveland, O.
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C. H. Besly & Co., Chicago, Ill.
Swarts Metal Refining Co., Chicago, Ill.
Perfect Lubricating Metal Co., Cincinnati, O.
Merchant & Co., Inc., Philadelphia, Pa.
F. R. Phillips Sons' Co., Philadelphia, Pa.
J. J. Ryan & Co., Chicago, Ill.

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The Chicago Rawhide Mfg. Co., Chicago, Ill.
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BLAST FURNACE WORK—
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Meehan Boiler & Construction Co., Lowellville, Ohio.
The Wm. B. Pollock Co., Youngstown, O.
Riter-Conley Mfg. Co., Pittsburg, Pa.
Southwark Foundry & Machine Co., Philadelphia, Pa.

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Cahall Sales Department, Pittsburg, Pa.
Enterprise Boiler Co., Youngstown, O.
The Edward P. Allis Co., Milwaukee, Wis.
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Harrison Safety Boiler Works, Philadelphia.
Meehan Boiler & Construction Co., Lowellville, O
Wm. Cramp & Sons, Philadelphia, Pa.
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The Aultman Co., Canton, O.
Fraser & Chalmers, Chicago, Ill.
Excelsior Iron Works Co., Cleveland, O.
James Bonar & Co., Pittsburgh, Pa.
W. P. Davis Machine Co., Rochester, N. Y.

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Union Boiler Tube Cleaner Co., Pittsburg, Pa.

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National Tube Co., Pittsburg, Pa.

BOILER TUBE CLEANERS—
Union Boiler Tube Cleaner Co., Pittsburg, Pa

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Upson Nut Co., Cleveland, O.

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Bickford Drill and Tool Co., Cincinnati, O.
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Lorain Foundry Co., Lorain, O.

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Shiffler Bridge Co., Pittsburg.
Riter-Conley Mfg. Co., Pittsburg, Pa.

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The Pressed Steel Car Co., Pittsburg, Pa.

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CAR WHEEL FOUNDRY PLANTS—
Whiting Foundry Equipment Co., Harvey, Ill.

CARRYING TONGS—
Vulcan Mfg. Co., Pittsburg, Pa.

CASE HARDENING MATERIALS—
American Carburizing Co., New York City.

CASTINGS—
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Hooven, Owens & Rentschler Co., Hamilton, O.
Macbeth & Co., Cleveland, O.
W. A. Jones Foundry Co., Chicago, Ill.
Brass Founders' Supply Co., Newark, N. J.
The Aultman Co., Canton, O.
Riverside Foundry Co., Cleveland, O.
Wheeling Mold & Foundry Co., Wheeling, W. Va.
Lorain Foundry Co., Lorain, O.
Bethlehem Steel Co., South Bethlehem, Pa.

CASTINGS (ALUMINUM)
J. J. Ryan & Co., Chicago, Ill.

CASTINGS (BRASS)—
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Lorain Foundry Co Lorain, O.

CASTINGS (BRONZE)—
J. J. Ryan & Co., Chicago, Ill.
Lorain Foundry Co., Lorain, O.

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Acme Malleable Iron Works, Buffalo, N. Y.
Buhl Malleable Co., Detroit Mich.
Forster, Waterbury & Co., Chicago, Ill.

CEMENT—
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Garden City Sand Co., Chicago, Ill.
Reed F. Blair & Co., Pittsburg, Pa.

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CHAIN BELTING—
Heyl & Patterson, Pittsburg, Pa.
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The Aultman Co., Canton, O.
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O. Textor, Cleveland, O.
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John T. Jones & Co., Chicago, Ill.
Cremer & Bicknell, Cleveland, O.
We Fu Go Co. Cincinnati, O.

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Seaman, Sleeth Co., Pittsburg, Pa.
Riverside Foundry Co., Cleveland, O.
Totten & Hogg Iron and Steel Foundry Co., Pittsburg, Pa.
F. R. Phillips Sons' Co., Philadelphia, Pa.
Lorain Foundry Co., Lorain, O.

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Skinner Chuck Co., New Britain, Conn.

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Jeffrey Mfg. Co., Columbus, O.

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Jeffrey Mfg. Co., Columbus, O.
The Aultman Co., Canton, O.

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Rogers, Brown & Co., Cincinnati, O
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H. C. Frick Coke Co., Pittsburg, Pa.
McKeefrey & Co., Leetonia, O.
Washington Coal and Coke Co., Pittsburg, Pa.
Pickands, Mather & Co., Cleveland, O.

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Webster Camp & Lane Machine Co., Akron, O

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The Ingersoll-Sergeant Drill Co., New York.
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American Pneumatic Tool Co., New York City.
Manning, Maxwell & Moore, New York City.
W. J. Schaefer & Co., New York City.

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Geo. B. Sennett Co., Youngstown, Ohio.

CONTRACTORS FOR CLEANING BOILERS—
Union Boiler Tube Cleaner Co., Pittsburg, Pa.

CONVEYORS—
Jeffrey Mfg. Co., Columbus, O.
Heyl & Patterson, Pittsburg, Pa.
Link-Belt Machinery Co., Chicago, Ill.
The Aultman Co., Canton, O.
The Brown Hoisting and Conveying Machine Co., Cleveland, O.
Webster Camp & Lane Machine Co., Akron, O.

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Millett Core Oven Co., Brightwood, Mass.

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Berger Mfg. Co., Canton, O.
Ætna-Standard Iron & Steel Co., Bridgeport, O.
Cincinnati Corrugating Co., Piqua, O.
Wm. B. Scaife & Sons, Pittsburg, Pa.

COTTON TIES—
American Steel Hoop Co., Pittsburg, Pa.

CRANES—
Northern Engineering Works, Detroit, Mich.
Wm. Tod & Co., Youngstown, O.
Marion Steam Shovel Co., Marion, O.
Reading Crane & Hoist Works, Reading, Pa.
The Bucyrus Co., South Milwaukee, Wis.
Whiting Foundry Equipment Co., Harvey, Ill.
Brown Hoisting and Conveying Machine Co., Cleveland, Ohio.
Excelsior Iron Works Co., Cleveland, O.
Manning, Maxwell & Moore, New York City.
Cleveland Crane & Car Co., Cleveland, O.

CRANK HANDLES—
Norwood Bicycle Co., Cincinnati, O.

CUPOLAS—
Riter-Conley Mfg. Co., Pittsburg, Pa.
Northern Engineering Works, Detroit, Mich.
Whiting Foundry Equipment Co, Harvey, Ill.

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DREDGES—
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DRILL PRESSES—
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C. H. Besly & Co., Chicago, Ill.
U. Baird Machinery Co., Pittsburg, Pa.
Bickford Drill & Tool Co., Cincinnati, O.
Baush & Harris Machine Tool Co., Springfield, Mass.
Manning, Maxwell & Moore, New York City.
Danielson Machine & Tool Co., Cleveland, O.

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Jas. H Baker Mfg. Co., Pittsburg, Pa.

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Baush & Harris Machine Tool Co., Springfield, Mass.

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Bertsch & Co., Cambridge City, Ind.
C. H. Besly & Co., Chicago, Ill.
E. Konigslow & Bro., Cleveland, O.
Danielson Machine & Tool Co, Cleveland, O.

DYNAMOS—
Jeffrey Mfg. Co., Columbus, O.

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ELEVATORS—
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Lidgerwood Mfg. Co., New York City.
The Aultman Co., Canton, O.
The Brown Hoisting and Conveying Machine Co., Cleveland, O.
Webster Camp & Lane Machine Co., Akron, O
Buhl Malleable Co., Detroit, Mich.
Excelsior Iron Works Co., Cleveland, O.

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Northampton Emery Wheel Co., Chicago, Ill.
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Northampton Emery Wheel Co., Chicago, Ill.
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Wellman-Seaver Engineering Co., Cleveland, O.
Walter Kennedy, Pittsburg, Pa.
Heyl & Patterson, Pittsburg, Pa.
Meehan Boiler & Construction Co., Lowellville, O
K. E. Erickson, Pittsburg, Pa.
John T. Jones & Co., Chicago, Ill.
Riter-Conley Mfg. Co., Pittsburg, Pa.
Jeffrey Mfg. Co., Columbus, O.
Alex Laughlin & Co., Pittsburg, Pa.
We Fu Go Co., Cincinnati, O.
James Bonar & Co., Pittsburg, Pa.

ENGINE PACKING—
Jenkins Bros., New York City.
C. H. Besly & Co., Chicago, Ill.
James B. Clow & Sons, Chicago, Ill.

ENGINEERS' SUPPLIES—
C. H. Besly & Co., Chicago, Ill.
Jenkins Bros., New York City.
James B. Clow & Sons, Chicago, Ill.

ENGINE LATHES—
U. Baird Machinery Co., Pittsburg, Pa.
American Tool Works Co., Cincinnati, O.

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The Hooven, Owens & Rentschler Co., Hamilton, O.
The Aultman Co., Canton, O.
Geo. B. Sennett Co., Youngstown, Ohio.

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National Engraving Co., Cleveland, O.,
Samuel R. Mason, Cleveland, O

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We Fu Go Co., Cincinnati, O.
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F. B. Stevens, Detroit, Mich.
Chicago Fire Clay Product Co., Chicago, Ill.
Scioto Star Fire brick Works, Portsmouth, O.
Kentucky Fire Brick Works, Portsmouth O.
Webster Fire Brick Co., South Webster, O.
Ætna Fire Brick Co., Oak Hill, O.
Oak Hill Fire Brick & Coal Co., Oak Hill, O.
Holmes, Strachan & Co., Detroit, Mich.
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FLUE CLEANERS—
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Riverside Foundry Co., Cleveland, O.
I. & E. Greenwald Co., Cincinnati, O.
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Excelsior Iron Works Co., Cleveland, O.
Macbeth & Co., Cleveland, O.

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Tabor Mfg. Co., Elizabeth, N. J.
Millett Core Oven Co., Brightwood, Mass.
Brass Founders Supply Co., Newark, N. J.
Vulcan Mfg. Co., Pittsburg, Pa.
Northern Engineering Works, Detroit, Mich.
Cleveland Crane & Car Co., Cleveland, O.
Whiting Foundry Equipment Co, Harvey, Ill.

FOUNDRY FACINGS—
Cleveland Facing Mill Co., Cleveland, O

FOUNDRY SUPPLIES—
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Chas. Taylor's Sons Co., Cincinnati, O.
Miller & Hays Akron, O.
Clearfield Fire Brick Co., Clearfield, Pa.
Cleveland Crane & Car Co, Cleveland, O.
The Ohio Sand Co., Conneaut, O.
Union Mining Co., Mt. Savage, Md.
Dover Fire-Brick Co., Cleveland, O.
A. F. Smith & Co., New Brighton, Pa.

Tabor Mfg. Co., Elizabeth, N. J.
F. B. Stevens, Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
Millett Core Oven Co., Brightwood, Mass.
Cleveland Facing Mill Co., Cleveland, O.
Garden City Sand Co., Chicago, Ill.
Chicago Fire Clay Product Co., Chicago, Ill.
Brass Founders' Supply Co., Newark, N. J.
Vulcan Mfg. Co., Pittsburg, Pa.
Scioto Star Fire Brick Works, Portsmouth, O.
Kentucky Fire Brick Works, Portsmouth, O.
Webster Fire Brick Co., South Webster, O.
Ætna Fire Brick Co., Oak Hill, O.
J. V. Rose, Sharon, Pa.
Oak Hill Fire Brick & Coal Co., Oak Hill, O.
Holmes, Strachan & Co., Chicago, Ill.
Newport Sand Bank Co., Newport, Ky.

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Magnolia Metal Co., New York City.
Periect Lubricating Metal Co., Cincinnati, O.
Merchant & Co., Inc., Philadelphia, Pa.
F. R. Phillips' Sons Co., Philadelphia, Pa.
J. J. Ryan & Co., Chicago. Ill.

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FURNACE LININGS—
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FURNACE, MELTING—
Whiting Foundry Equipment Co., Harvey, Ill.

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W. S. Rockwell & Co., New York City.

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Apollo Iron & Steel Co., Pittsburg, Pa.

GALVANIZERS—
Ætna-Standard Iron & Steel Co., Bridgeport, O
Apollo Iron & Steel Co., Pittsburg, Pa.

GALVANIZING POTS—
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Northern Engineering Works, Detroit, Mich.

GAUGE COCKS—
James Bonar & Co., Pittsburg, Pa.

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The Van Dorn & Dutton Co., Cleveland, O.
Fraser & Chalmers, Chicago, Ill.
Southwark Foundry & Machine Co., Philadelphia, Pa.
James Bonar & Co., Pittsburg, Pa.

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The Van Dorn & Dutton Co., Cleveland, O.

GEAR LUBRICANTS—
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Brass Founders' Supply Co., Newark, N. J.

HACK SAWS—
Q & C Co., Chicago, Ill.

HANDLES—
Norwood Bicycle Co., Cincinnati, O.

HANGERS—
E. A. Delano, Chicago, Ill.
Dodge Mfg. Co., Mishawaka, Ind.
The Aultman Co., Canton, O.
Jones & Laughlins, Ltd., Pittsburg, Pa.
I. & E. Greenwald Co., Cincinnati, O.

HARNESS SNAPS—
Covert Mfg. Co., West Troy, N. Y.

HOISTS—
Reading Crane & Hoist Works, Reading, Pa.
The Aultman Co., Canton, O.
Lidgerwood Mfg. Co., New York City.

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Harrison Safety Boiler Works, Philadelphia.
James Bonar & Co., Pittsburg, Pa.
We Fu Go Co., Cincinnati, O.
Austin Separator Co., Detroit, Mich.

HEAVY HARDWARE—
C. H. Besly & Co , Chicago, Ill.
Parkhurst & Wilkinson Co., Chicago, Ill.

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The Edward P. Allis Co., Milwaukee, Wis.
Lidgerwood Mfg. Co., New York City.
The Aultman Co., Canton, O.
Webster, Camp & Lane Machine Co., Akron, O.
Excelsior Iron Works Co., Cleveland, O

HOISTING MACHINERY—
Link-Belt Machinery Co., Chicago, Ill.
Reading Crane & Hoist Works, Reading, Pa.
Jeffrey Mfg. Co., Columbus, O.
Excelsior Iron Works Co., Cleveland, O.
Lidgerwood Mfg. Co., New York City.
Heyl & Patterson, Pittsburg, Pa.
The Aultman Co., Canton, O.
The Brown Hoisting and Conveying Machine Co., Cleveland, O.
Webster, Camp & Lane Machine Co., Akron, O.

HORSE SHOES—
Phoenix Horse Shoe Co., Joliet, Ill.

HOTELS—
United States Hotel Co., Cleveland, O.

IMPULSE CLEANERS—
Union Boiler Tube Cleaner Co., Pittsburg, Pa.

INDUSTRIAL CARS—
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Manning, Maxwell & Moore, New York City.
James Bonar & Co., Pittsburg, Pa.

INSURANCE COMPANIES—
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IRON BUILDINGS—
Universal Construction Co., Chicago, Ill.
Schiffler Bridge Co., Pittsburg, Pa.
Riter-Conley Co., Pittsburg, Pa.
Wm. B. Scaife & Sons, Pittsburg, Pa.

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L. K. Hirsch, Chicago, Ill.

IRON AND STEEL ROOFING—
Berger Mfg. Co., Canton, O.
Ætna-Standard Iron & Steel Co., Bridgeport, O.
Cincinnati Corrugating Co., Piqua, O.
Wm. B. Scaife & Sons, Pittsburg, Pa.

IRON ORE—
Lake Superior Consolidated Iron Mines New York City, N. Y.
Oglebay, Norton & Co., Cleveland, O.
M. A. Hanna & Co., Cleveland, O.
Drake Bartow & Co., Cleveland, O.
Pickands, Mather & Co., Cleveland, O.

IRON WORKING TOOLS—
Avery Stamping Co., Cleveland, O.
American Tool Works Co., Cincinnati, O.
H. Bickford, Lakeport, N. H.
C. H. Besly & Co., Chicago, Ill.
U. Baird Machinery Co., Pittsburg, Pa.
Armstrong Bros. Tool Co., Chicago, Ill.
The Armstrong Mfg. Co., Bridgeport, Conn.
Bickford Drill & Tool Co., Cincinnati, O.
Skinner Chuck Co., New Britain, Conn.
Baush & Harris Machine Tool Co., Springfield, Mass
W. P. Davis Machine Co., Rochester, N. Y.
Manning, Maxwell & Moore, New York City.
Bertsch & Co., Cambridge City, Ind.
Skinner Chuck Co., New Britain, Conn.

LADLES—
Northern Engineering Works, Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

LATHES—
W. P. Davis Machine Co., Rochester, N. Y.
U. Baird Machinery Co., Pittsburg, Pa.
Bickford Drill & Tool Co., Cincinnati, O.
Danielson Machine & Tool Co., Cleveland, O.
Manning, Maxwell & Moore, New York City.
American Tool Works Co., Cincinnati, O.

LINK BELTING—
The Jeffrey Mfg. Co., Columbus, O.
Link-Belt Machinery Co., Chicago, Ill.
Heyl & Patterson, Pittsburg, Pa.
The Aultman Co., Canton, O.

LOCOMOTIVES—
L. K. Hirsch, Chicago, Ill.
Hyde Bros. & Co., Pittsburg, Pa

MACHINISTS' TOOLS AND SUPPLIES—
American Tool Works Co., Cincinnati, O.
W. P. Davis Machine Co., Rochester, N. Y.
H. Bickford, Lakeport, N. H.
C. H. Besly & Co., Chicago, Ill.
U. Baird Machinery Co., Pittsburg, Pa.
Bertsch & Co., Cambridge City, Ind.
Armstrong Bros. Tool Co., Chicago, Ill.
Bickford Drill & Tool Co., Cincinnati, O.
Parkhurst & Wilkinson Co., Chicago, Ill.
Skinner Chuck Co., New Britain, Conn.
Baush & Harris Machine Tool Co., Springfield Mass.
Danielson Machine & Tool Co., Cleveland, O.
Manning, Maxwell & Moore, New York City.

MACHINE SCREWS—
C. H. Besly & Co., Chicago, Ill.

MACHINE SHOPS—
The R. D. Nuttall Co., Allegheny, Pa.
Danielson Machine & Tool Co., Cleveland, O.

MACHINERY AND TOOL STEEL—
C. H. Besley & Co., Chicago, Ill.
Bræburn Steel Co., Bræburn, Pa.
Crescent Steel Co., Pittsburg, Pa.
La Belle Steel Co., Pittsburg, Pa
Byron H. White, Chicago, Ill.
Morris & Bailey Steel Co., Pittsburg, Pa.
Monongahela Iron & Steel Co., Pittsburg, Pa.

MAGNESIA COVERING—
C. H. Besly & Co., Chicago, Ill.
James B. Clow & Sons, Chicago, Ill.

MALLEABLE FOUNDRY PLANTS—
Whiting Foundry Equipment Co., Harvey, Ill.

MALLEABLE CASTINGS—
Acme Malleable Iron Works, Buffalo, N. Y.
Buhl Malleable Co., Detroit, Mich.
Forster, Waterbury & Co., Chicago, Ill.

MANUFACTURING CHEMISTS—
We Fu Go Co., Cincinnati, O.

MANUFACTURED IRON AND STEEL—
Bourne-Fuller & Co., Cleveland, O.
Ætna-Standard Iron & Steel Co., Bridgeport, O.
The Morris & Bailey Steel Co., Pittsburg, Pa.
Parkhurst & Wilkinson Co., Chicago, Ill.
Ohio Steel Co., Youngstown, O.
Republic Iron & Steel Co., Chicago, Ill.
Monongahela Iron & Steel Co., Pittsburg, Pa.

METAL BEARINGS—
Theo. Hiertz & Son, St. Louis, Mo.
C. H. besly & Co., Chicago, Ill.
Perfect Lubricating Metal Co., Cincinnati, O.
Merchant & Co., Inc., Philadelshia, Pa.
Magnolia Metal Co., New York City.
Swarts Metal Refining Co., Chicago, Ills.
F. R. Phillips' Sons Co., Philadelphia, Pa.
J. J. Ryan & Co., Chicago, Ill.

METAL CEILINGS—
Berger Manufacturing Co., Canton, O.

METAL WORK—
Avery Stamping Co , Cleveland, O.

MILLING MACHINES—
American Tool Works Co., Cincinnati, O.
W. P. Davis Machine Co., Rochester, N. Y.
U. Baird Machinery Co., Pittsburg, Pa.
Danielson Machine & Tool Co., Cleveland, O.
Manning, Maxwell & Moore, New York City.

MINING MACHINERY—
C. H. Besly & Co., Chicago, Ill.
The Edward P. Allis Co., Milwaukee, Wis,
Jeffrey Mfg. Co., Columbus, O.
Lidgerwood Mfg. Co., New York City.
Wm. Cramp & Sons, Philadelphia, Pa
The Bucyrus Co., South Milwaukee, Wis.
Marion Steam Shovel Co., Marion, O.
Webster, Camp & Lane Machine Co., Akron, O.
Fraser & Chalmers, Chicago, Ill.
Excelsior Iron Works Co., Cleveland, O.

MINE PUMPS—
F. M. Prescott Steam Pump Co., Milwaukee, Wis.

MOLDING MACHINES—
Tabor Mfg. Co., Elizabeth, N. J.
Whiting Foundry Equipment Co., Harvey, Ill.

MOLDING SAND—
Ohio Sand Co., Conneaut, O.
F. B. Stevens, Detroit, Mich.
Garden City Sand Co., Chicago, Ill.
Newport Sand Bank Co., Newport, Ky.

MULTIPLE DRILLS—
Bickford Drill and Tool Co., Cincinnati, O.
Baush & Harris Machine Tool Co., Springfield, Mass.

NICKEL PLATING OUTFITS—
Northampton Emery Wheel Co., Chicago, Ill.

NUTS AND BOLTS—
Upson Nut Co., Cleveland, O.

OILLESS BEARINGS—
C. H. Besly & Co., Chicago, Ill.

OIL BURNERS—
W. S. Rockwell & Co., New York City.

OIL CUPS—
C. H. Besly & Co., Chicago, Ill.
James Bonar & Co., Pittsburg, Pa

OIL FILTERS—
James Bonar & Co., Pittsburg, Pa.

OIL PUMPS—
C. H. Besly & Co., Chicago, Ill.

OIL SEPARATORS—
Harrison Safety Boiler Works, Philadelphia, Pa.
Austin Separator Co., Detroit, Mich.

ORE CARS—
The Pressed Steel Co. Pittsburg, Pa.

ORE CRUSHERS—
The Edward P. Allis Co., Milwaukee, Wis.
Jeffrey Mfg. Co., Columbus, O.
The Aultman Co., Canton, O.
Fraser & Chalmers Chicago, Ill.

ORE SCREENS—
Rob't Aitchison Per. Metal Co., Chicago, Ill.
The Aultman Co., Canton, O.
Fraser & Chalmers, Chicago, Ill.
James Bonar & Co., Pittsburg, Pa.

PACKING—
C. H. Besly & Co., Chicago, Ill.
Jenkins Bros., New York City.
James B. Clow & Sons, Chicago, Ill.

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Iron Clad Paint Co., Cleveland, O.
Jos. Dixon Crucible Co., Jersey City, N. J.

PATTERN WORKS—
Gobeille Pattern Co., Cleveland, O.
Forsythe Pattern Works, Youngstown, O.

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Aitchison Perforated Metal Co., Chicago, Ill.
Fraser & Chalmers, Chicago, Ill.
Hendrick Mfg. Co., Carbondale, Pa.

PIG IRON—
Rogers, Brown & Co., Cincinnati, O.
Reed F. Blair & Co., Pittsburg, Pa.
Clinton Iron & Steel Co., Pittsburg.
Forster, Waterbury & Co., Chicago, Ill.
Bourne-Fuller Co. Cleveland, O.
M. A. Hanna & Co., Cleveland, O.
R. H. Stroud & Co., Chicago, Ill.
F. B. Stevens, Detroit, Mich.
McKeefrey & Co., Leetonia, O.
Superior Charcoal Iron Co., Grand Rapids, Mich
Spearman Iron Co., Sharpsville, Pa.
Hickman, Williams & Co., Chicago, Ill,
The Brier Hill Coal & Iron Co., Youngstown, O.
Pickands, Mather & Co., Cleveland, O.
Republic Iron & Steel Co., Chicago, Ill.
American Steel Hoop Co., Pittsburg, Pa.
American Steel & Wire Co., Chicago, Ill,

PIG IRON CASTING APPARATUS—
Heyl & Patterson, Pittsburg, Pa.
G. H. Ginther, Special Agent, Pittsburg, Pa.

PIPE (CAST IRON)—
James B. Clow & Sons, Chicago, Ill.

PIPE (RIVETED STEEL)—
Wm. B. Scaife & Sons, Pittsburg, Pa.

PIPE CLEANERS—
Union Boiler Tube Cleaner Co., Pittsburg, Pa.

PIPE COVERING—
C. H. Besly & Co., Chicago, Ill.
Jenkins Bros., New York City.

PIPE CUTTING AND THREADING MACHINES—
The Armstrong Mfg. Co., Bridgeport, Conn.

PIPE FOUNDRY PLANTS—
Whiting Foundry Equipment Co., Harvey, Ill.

PLANERS—
W. P. Davis Machine Co., Rochester, N. Y.
U. Baird Machinery Co., Pittsburg, Pa.
Bickford Drill & Tool Co., Cincinnati, O.
Danielson Machine & Tool Co., Cleveland, O
Manning, Maxwell & Moore, New York City.
American Tool Works Co., Cincinnati, O.

PLATES—
Enterprise Boiler Co., Youngstown, O.
Republic Iron & Steel Co., Chcago, Ill.
Universal Construction Co., Chicago, Ill.

PLUMBERS' AND GAS FITTERS' SUPPLIES—
C. H. Besly & Co., Chicago, Ill.
James B. Clow & Sons, Chicago, Ill.

PNEUMATIC APPLIANCES—
Clayton Air Compressor Works, New York.

PNEUMATIC TOOLS—
American Pneumatic Tool Co., New York City
Q & C Co., Chicago, Ill.
W. J. Schaefer & Co., New York City.

PORTABLE FORGE—
C. H. Besly & Co., Chicago, Ill.
Vulcan Mfg. Co., Pittsburg, Pa.

POWER DROP HAMMERS—
Baush & Harris Machine Tool Co., Springfield Mass.

POWER PRESSES—
Avery Stamping Co., Cleveland, O.
Bertsch & Co., Cambridge City, Ind.
E. Konigslow & Bro. Cleveland, O.
Danielson Machine & Tool Co., Cleveland, O.

POWER TRANSMISSON MACHINERY—
Jeffrey Mfg. Co., Columbus, O.
E. A. Delano, Chicago, Ill.
Dodge Mfg. Co., Mishawaka, Ind.
The Aultman Co., Canton, O.
Jones & Laughlins, Ltd., Pittsburg, Pa.
I. & E. Greenwald Co., Cincinnati, O.

PRESSES—
Bertsch & Co., Cambridge City, Ind.
C. H. Besly & Co., Chicago, Ill.
E. Konigslow & Bro. Cleveland, O.
Danielson Machine & Tool Co., Cleveland, O.
Avery Stamping Co., Cleveland, O.

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The Bristol Co., Waterbury, Conn.
James Bonar & Co., Pittsburg, Pa.

PULLEYS—
W. A. Jones Foundry Co., Chicago, Ill
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Dodge Mfg. Co., Mishawaka, Ind.
The Aultman Co., Canton, O.
Jeffrey Mfg. Co., Columbus, O.
Jones & Laughlins, Ltd., Pittsburg, Pa
I. & E. Greenwald Co., Cincinnati, O.

PUMPS (STEAM)—
The Edward P. Allis Co., Milwaukee, Wis
Blakeslee Mfg. Co., Du Quoin, Ill.
Fred M. Prescott Steam Pump Co., Milwaukee Wis.
Hall Steam Pump Co., Pittsburg, Pa.
Southwark Foundry & Machine Co., Philadelphia, Pa.

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PYROMETERS—
Edward Brown, Philadelphia, Pa.
Vulcan Mfg. Co., Pittsburg, Pa.

RADIAL DRILLS—
Bickford Drill and Tool Co., Cincinnati, O.
Baush & Harris Machine Tool Co., Springfield, Mass.

RAILS—
L. K. Hirsch, Chicago, Ill.
Hyde Bros. & Co., Pittsburg, Pa.

RAILWAY SUPPLIES—
Cleveland City Forge & Iron Co., Cleveland, O.
Garden City Sand Co., Chicago, Ill.
L. K. Hirsch, Chicago, Ill.

RELAYING RAILS—
L. K. Hirsch, Chicago, Ill.
Hyde Bros. & Co., Pittsburg, Pa.

RIVETS—
Champion Rivet Co., Cleveland, O.
Jonse & Laughlins, Ltd., Pittsburg, Pa.

RIVETED STEEL PIPE—
The Wm. B. Pollock Co. Youngstown, O.

ROCK DRILLS—
Rand Drill Co., Chicago, Ill.
The Ingersoll-Sergeant Drill Co., New York.

ROLL FORGINGS—
Samuel Trethewey & Co., Pittsburg, Pa.

ROLLING MILL MACHINERY—
Totten & Hogg Iron and Steel Foundry Co., Pittsburg, Pa.
F. R. Phillips' Sons Co., Philadelphia, Pa
Whiting Foundry Equipment Co., Harvey, Ill.

ROOFS—
Shiffler Bridge Co., Pittsburg.
Riter-Conley Mfg. Co., Pittsburg, Pa.
Wm. B. Scaife & Sons, Pittsburg, Pa.

SAWS—
Peter Gerlach & Co., Cleveland, O.

SCRAP IRON—
L. K. Hirsch, Chicago, Ill.
Hyde Bros. & Co., Pittsburg, Pa.
Universal Construction Co., Chicago, Ill.

SCREENS FOR COAL, ORE, ETC.—
Robt Aitchison Perforated Metal Co., Chicago.
Hendrick Mfg. Co., Carbondale, Pa.
Jeffrey Mfg. Co., Columbus, O.
The Aultman Co., Canton, O.
Fraser & Chalmers, Chicago, Ill.

SCREWS—
C. H. Besly & Co., Chicago, Ill.
Upson Nut Co., Cleveland, O.
Chicago Screw Co., Chicago, Ill

SCREW MACHINES—
Cleveland Ball & Screw Co., Cleveland, O.

SECOND-HAND MACHINERY—
L. K. Hirsch, Chicago, Ill.
Hyde Bros. & Co., Pittsburg, Pa.
Geo. D. Moffet & Co., Chicago, Ill.

SEPARATORS—
Harrison Safety Boiler Works, Philadelphia, Pa.
Austin Separator Co., Detroit, Mich.

SHAFTING—
E. A. Delano, Chicago, Ill.
Dodge Mfg. Co., Mishawaka, Ind.
Fitzsimmons & Co., Cleveland, O.
The Aultman Co., Canton, O.
Jeffrey Mfg. Co., Columbus, O.
Jones & Laughlins, Ltd., Pittsburg, Pa
I. & E. Greenwald Co., Cincinnati, O.
Bethlehem Steel Co., South Bethlehem, Pa.
American Steel & Wire Co., Chicago, Ill.

SHAPERS—
W. P. Davis Machine Co., Rochester, N. Y.
Baush & Harris Machine Tool Co., Springfield, Mass.
American Tool Works Co., Cincinnati, O.

SHEARING AND PUNCHING MACHINERY—
Bertsch & Co., Cambridge City, Ind.
Danielson Machine & Tool Co., Cleveland, O.

SHEAR KNIVES—
Samuel Trethewey & Co., Pittsburg, Pa

SHEET IRON—
Ætna-Standard Iron & Steel Co., Bridgeport, O.
E. H. Stroud & Co., Chicago, Ill.
Republic Iron & Steel Co., Chicago, Ill.
Struthers Iron & Steel Co., Struthers, O.

SHIP YARDS—
Wm. Cramp & Sons, Philadelphia, Pa.

SOLID STEEL SHEAR KNIVES—
Samuel Trethewey & Co., Pittsburg, Pa.

SPIKES—
L. K. Hirsch, Chicago, Ill.

SPECIAL MACHINERY—
American Tool Works Co., Cincinnati, O.
James Bonar & Co., Pittsburg, Pa.
Avery Stamping Co., Cleveland, O.
Q & C Co., Chicago, Ill.
The Aultman Co., Canton, O.
Jeffrey Mfg. Co., Columbus, O.
E. Konigslow & Bro. Cleveland, O.
Wheeling Mold & Foundry Co., Wheeling, W. Va.
Danielson Machine & Tool Co., Cleveland, O.

STACKS—
Wm. B. Scaife & Sons, Pittsburg, Pa.

STAND PIPES—
The Wm. B. Pollock Co., Youngstown, O.

STEAM BOILER INSPECTORS—
Hartford Steam Boiler Inspection & Insurance Co., Hartford, Conn.

STEAM PIPE AND BOILER COVERING—
C. H. Besly & Co., Chicago Ill.

STEAM PACKING—
James B. Clow & Sons, Chicago, Ill.
C. H. Besly & Co., Chicago, Ill.

STEAM PUMPS—
Hall Steam Pump Co., Pittsburg, Pa.
Blakeslee Mfg. Co., Du Quoin, Ill.
Fred. M. Prescott Steam Pump Co., Milwaukee, Wis.
Edw. P. Allis Co., Milwaukee, Wis.
Southwark Foundry and Machine Co., Philadelphia, Pa.
James Bonar & Co., Pittsburg, Pa.

STEAM SEPARATORS—
James Bonar & Co., Pittsburg, Pa.
Austin Separator Co., Detroit, Mich.
Harrison Safety Boiler Works, Philadelphia, Pa.

STEAM SHOVELS AND DREDGES—
Marion Steam Shovel Co., Marion, O
The Bucyrus Co., South Milwaukee, Wis.

STEAM SPECIALTIES—
C. H. Besly & Co., Chicago, Ill.
James Bonar & Co., Pittsburg, Pa.

STEEL—
Otis Steel Co., Cleveland, O.
E. H. Stroud & Co., Chicago, Ill.
Braeburn Steel Co., Braeburn, Pa.
Crescent Steel Co., Pittsburg, Pa.
La Belle Steel Co., Pittsburg, Pa.
The Morris & Bailey Steel Co., Pittsburg, Pa.
Byron H. White, Chicago, Ill.
Monongahela Iron & Steel Co., Pittsburg, Pa.
American Steel Hoop Co., Pittsburg, Pa.
American Steel & Wire Co., Chicago, Ill.
Struthers Iron & Steel Co., Struthers, O.

STEEL BALLS—
Cleveland Ball & Screw Co., Cleveland, O.
Norwood Bicycle Co., Cincinnati, O.

STEEL BANDS—
American Steel Hoop Co., Pittsburg, Pa.
American Steel & Wire Co Chicago, Ill.

STEEL BLOOMS AND BILLETS—
American Steel & Wire Co., Chicago, Ill.
National Steel Co., Chicago, Ill.
Bethlehem Steel Co., South Bethlehem, Pa.
The Lorain Steel Co., Lorain, O.
Jones & Laughlins, Ltd., Pittsburg, Pa.
American Steel Hoop Co., Pittsburg, Pa.

STEEL CARS—
The Pressed Steel Car Co., Pittsburg, Pa.

STEEL CASTINGS—
Otis Steel Co., Cleveland, O.
Q & C Co., Chicago, Ill.
Bethlehem Steel Co., South Bethlehem, Pa.

STEEL CEILINGS—
Berger Manufacturing Co., Canton, O.

STEEL FRAME MILL BUILDINGS—
Wm. B. Scaife & Sons, Pittsburg, Pa.

STEEL FOUNDRY PLANTS—
Whiting Foundry Equipment Co., Harvey, Ill

STEEL HOOPS—
American Steel Hoop Co., Pittsburg, Pa.

STEEL PLANTS—
The Wm. B. Pollock Co., Youngstown, O.
The Riter-Conley Co., Pittsburg, Pa.

STOKERS—
Playford Stoker Co., Cleveland, O.

TANKS—
Enterprise Boiler Co., Youngstown, O.
Meehan Boiler & Construction Co., Lowellville O.
Wm. B. Scaife & Sons, Pittsburg, Pa.
The Wm. B. Pollock Co., Youngstown, O.
Riter-Conley Mfg. Co., Pittsburg, Pa.
The Aultman Co., Canton, O.

TANK CARS—
The Wm. B. Pollock Co., Youngstown, O.

TIN AND TERNE PLATES—
E. H. Stroud & Co., Chicago, Ill.
American Tin Plate Company, Chicago, Ill.

TIN PLATE MACHINERY—
Totten & Hogg Iron and Steel Foundry Co. Pittsburg, Pa.
F. R. Phillips' Sons Co., Philadelphia, Pa.

TOOL STEEL—
C. H. Besly & Co., Chicago, Ill.
Braeburn Steel Co., Braeburn, Pa.
Crescent Steel Co., Pittsburg, Pa.
La Belle Steel Co., Pittsburg, Pa.
Monongahela Iron & Steel Co., Pittsburg, Pa.

TRAMWAY EQUIPMENT—
Whiting Foundry Equipment Co., Harvey, Ill.

TRANSMISSION MACHINERY—
Heyl & Patterson, Pittsburg, Pa.
Link-Belt Machinery Co., Chicago, Ill.
The Lane & Bodley Co., Cincinnati, O.
W. A. Jones Foundry & Machine Co., Chicago.
Jeffrey Mfg. Co., Columbus, O.
Dodge Mfg. Co., Mishawaka, Ind.
The Aultman Co., Canton, O.
Brown Hoisting and Conveying Machine Co., Cleveland, Ohio.

TROLLEY TRACKS—
Whiting Foundry Equipment Co., Harvey, Ill.
Northern Engineering Works, Detroit, Mich.
Miller & Hays, Akron, O.

TRUCKS—
Northern Engineering Works, Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

TUBES—
National Tube Co., Pittsburg, Pa.
S. Fix' Sons, Cleveland, O.

TUBE CLEANERS—
Union Boiler Tube Cleaner Co., Pittsburg, Pa.

TUBE WELDING—
S. Fix Sons, Cleveland, O.

TUMBLERS—
Northern Engineering Works, Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

TURNBUCKLES—
Republic Iron & Steel Co., Chicago, Ill.
Cleveland City Forge & Iron Co., Cleveland, O.

TWIST DRILLS—
C. H. Besly & Co., Chicago, Ill.

TWIST DRILL CASES—
Vulcan Mfg. Co., Pittsburg, Pa.

VALVES—
James B. Clow & Sons, Chicago, Ill.
C. H. Besly & Co., Chicago, Ill.
Jenkins Bros., New York City
Manning, Maxwell & Moore, New York City.
James Bonar & Co., Pittsburg, Pa.

WASHERS—
Avery Stamping Co., Cleveland, O.

WATER SOFTENING PLANTS—
We Fu Go Co., Cincinnati, O.

WIRE—
American Steel & Wire Co., Chicago, Ill.

WIRE COATING—
The Ironsides Company, Columbus, O.

WIRE FENCING—
American Steel & Wire Co., Chicago, Ill.

WIRE FILLER—
The Ironsides Company, Columbus, O.

WIRE MACHINERY—
S. W. Goodyear, Waterbury, Conn.

WIRE NAILS—
American Steel & Wire Co., Chicago, Ill.

WIRE ROPE COATING—
The Ironsides Company, Columbus, O.

WIRE ROPE FILLING—
The Ironsides Company, Columbus, O.

WOOD PULLEYS—
Dodge Mfg. Co., Mishawaka, Ind.

WROUGHT PIPE—
National Tube Co., Pittsburg, Pa.

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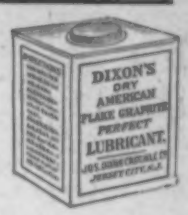

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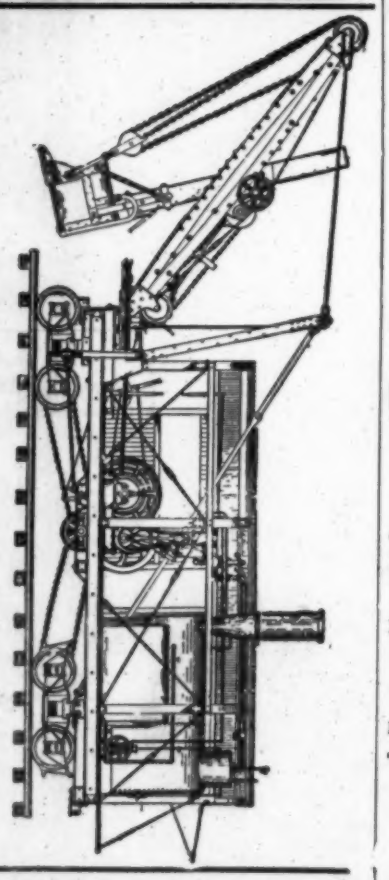

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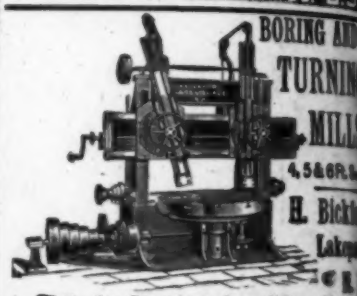

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